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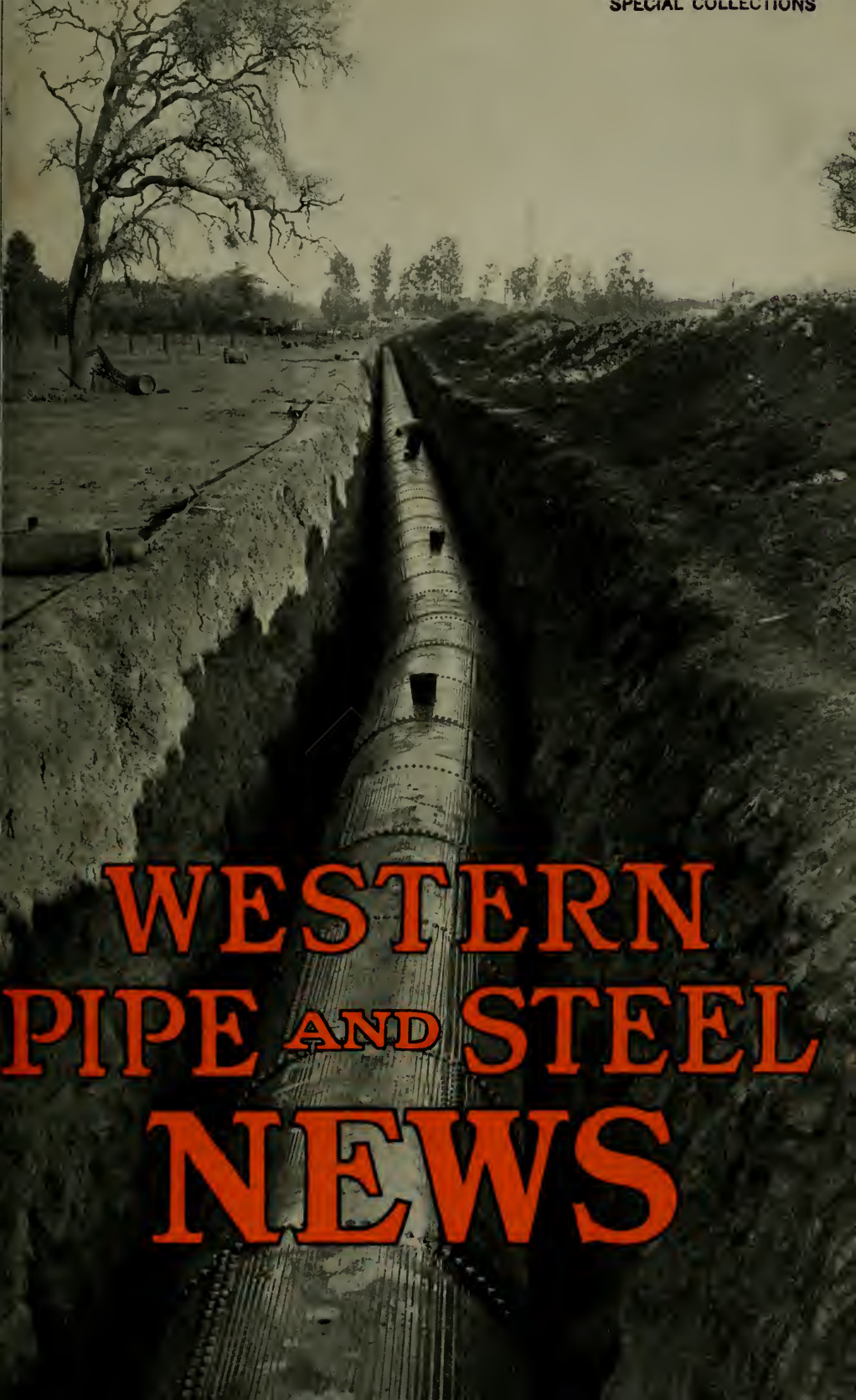


WESTERN PIPE AND STEEL NEWS

Water Pipe
Irrigation Pipe
Soil-Proof Pipe
Siphons
Well Casing
Corrugated Culvert
Penstocks
Water Tanks and Towers
Steel Flumes
Dredge Pipe
Galvanized Air Pipe
Oil Storage Tanks
Corrugated Tanks
Galvanized Tanks
Pressure Tanks
Gravity Tanks
Bolted Tanks
Gas Holders
Air Receivers, Condensers
Refuse Burners
Oil Refinery Equipment
Smoke Stacks
Special Shapes
Special Fittings
General Plate Work

SPECIAL COLLECTIONS

WESTERN PIPE *and* STEEL NEWS

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME 1 APRIL 1924 NUMBER 1

Pipe, Policy and Printer's Ink

BELIEVING that mutual understanding is the breath of life in the body of business, Western Pipe and Steel is establishing this more intimate contact with customers, present and prospective.

To supplement the work of an excellent sales force we are enlisting the aid of printer's ink, confident that we shall help both our customers and ourselves.

We propose to do two things in this publication: to broadcast helpful information, and to talk about Western Pipe and Steel.

It pays to advertise, provided nothing is claimed that cannot be proved, and the quality of the product measures up to the words that are used to describe it. It especially pays to advertise if the advertising does not begin and end as sales talk, but embodies a constructive program.

Our organization is staffed with specialists. Our business puts us in touch with other specialists. All these specialists have things to say that many men in many walks of life all over the Pacific Coast are waiting to hear. This publication will provide the specialists with a broadcasting station and an audience. In this issue a noted hydraulic engineer discusses the use of steel pipe in water works. We deem this a constructive contribution on an important topic. Mr. Elliott's article is an instance of what we mean by saying that we propose to broadcast helpful information.

We propose also to talk about Western Pipe and Steel, about ourselves. This talk will be quite impersonal. We mean by "ourselves," our plant, our workers, and the work we turn out. Speaking in this collective sense we may say for ourselves in all sincerity:

We believe there is a going value in good will. We try to deserve good will by proper business methods in the office, responsible representation in the field, and first-class workmanship in the plant. We have a single standard that controls all our relations—with our employees, with our customers, and with our competitors. That standard impels us to give a square deal and to exact no less. We are persuaded that self-respect and respect for others ought to go hand in hand.

It is quite in harmony with self-respect to say that we are proud of our organization, of what it has done, and of what it is equipped to do.

In this issue we address the man who wants to know about water pipe. We claim to speak with authority about water pipe. For years we have been making it in all diameters from four inches to fourteen feet, for all sorts of customers from individual farmers to utility companies and great municipalities.

The Use of Steel Pipe in Water Works

By G. A. Elliott, *Chief Engineer*
Spring Valley Water Company, San Francisco

THE subject of steel pipe is a broad one upon which volumes might be written. There are many subdivisions of the matter, any one of which would furnish the text for a paper in itself. Probably a brief discussion of some of the points that have been observed, or followed in practice, might be of interest. Necessarily the paper will deal with Western experience, more particularly with that on the Pacific Coast. Most of the experience of the writer regarding the life of plate pipes, has been in connection with riveted wrought iron mains. The early use of pipes of this sort in the West was in connection with hydraulic mining. Although the date cannot be definitely fixed, it is believed that as early as 1852 riveted iron pipes were used in the hydraulic mines of California. The plates for many of these pipes were imported from England. Due to the fact that the field joints were telescoped, the pipe was known locally as "stove pipe." Although hydraulic mining was discontinued many years ago, some of these old pipes were still in use for local water supplies in the small mountain villages a few years ago. The writer has examined some of them over sixty years old, and while in general the coating had practically disappeared, the metal showed only a very slight, evenly distributed rusting, with but little pitting.

The Spring Valley Water Company was one of the early users of riveted pipe. Under the direction of Mr. Her-

This riveted steel pipe has been soil-proofed according to the formula given by Mr. Elliott. "It is not unreasonable," he says, "to expect a life of from forty to fifty years."

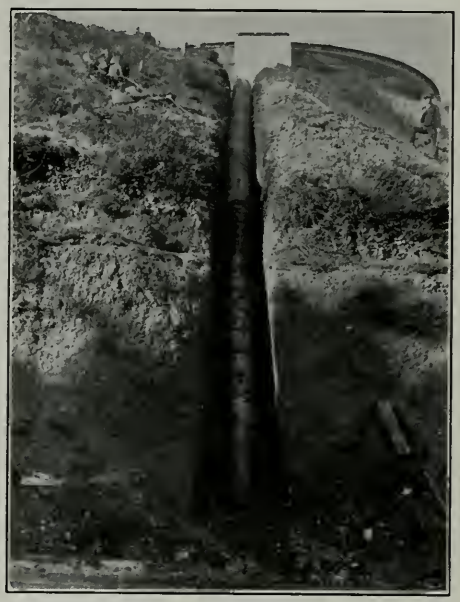
mann Schussler, then Chief Engineer of the Company, a 30-inch No. 12 gauge riveted iron pipe, 15 miles long, was laid in 1868. The last mile of this main was replaced in 1922, after having been in continuous use for fifty-four years. Fully 60 per cent of this section was in very good condition upon removal. At the present time 8 miles of 30-inch No. 12 gauge riveted iron pipe, laid in 1870, is used in bringing part of the supply to San Francisco. A still later riveted iron pipe is the 44-inch No. 6 gauge line, now 37 years old, used as part of the supply system, which, so far as can be ascertained from frequent inspection, seems to be in practically as good condition as the day it was laid. All of these pipes are laid in a light, well drained soil free from alkali . . .

The writer attributes the long life of these plate pipes to the coating and the character of the soils in which they are laid. The pipe dip used for the mains listed above, is one developed many years ago, consisting of a heated mixture of coal tar and asphaltum. During the past few years the custom of wrapping the dipped pipe with a composition paper has become prevalent. It costs only a few cents a foot additional, but is well worth the expenditure as an insurance against the breaking off of the coating next to the metal. Experience in connection with some of the long steel pipe lines laid in the alkaline soils of the San Joaquin Valley, which have been dipped in asphaltum and wrapped, indicates that the wrapping is well worth while. Probably a description of the method of using this protective covering would be of interest:

After manufacture, the pipe is to be cleaned of dirt, scale and rust, and dipped in asphaltum at a temperature of 360° F. and is to remain in the kettle until the metal has attained the temperature of the bath. After the pipe has been dipped it is to be spirally wrapped with mica covering, wrapping to be put on under a tension of not less than fifty (50) pounds per eighteen (18) inches width of wrapping. The ends of the wrapping at the joint connections are to be finished off by sealing with hot asphaltum.

The mica covering shall be of felt, which has been thoroughly saturated with a high melting point bituminous compound, containing not less than twenty-five (25) per cent by weight of an alkali resisting mineral. The finished product shall weigh not less than three and six-tenths (3.6) pounds per square yard. Flaked mica shall be applied to the side of the coating which will be on the outside of the pipe, in such quantities as to give the best results.

A twelve (12) inch strip of the covering long enough to give a four (4) inch longitudinal lap is to be furnished with each section of pipe, together with the necessary asphaltum for wrapping and sealing the field joints.



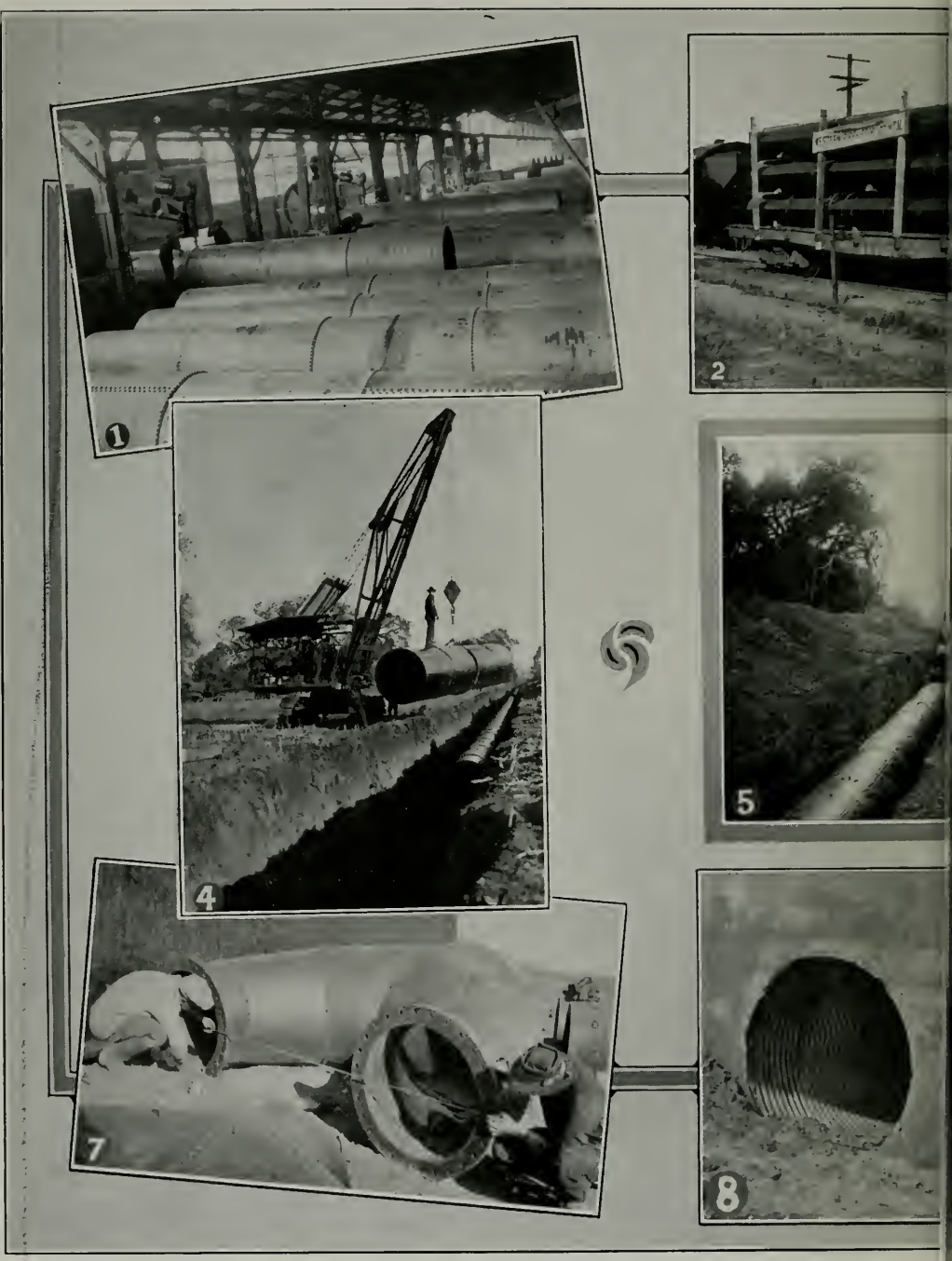
W. P. & S. riveted steel pipe laid in a side-hill trench at an angle of 45°. This 24" line, two miles long, was made for Spring Valley Water Company, San Francisco.

In general, the long life of the pipes mentioned above may be ascribed to the coating . . .

It has been the experience of the writer that where plate metal pipes have been carefully coated with a satisfactory protective covering material, and then laid in ordinary well drained, light soils, it is not unreasonable to expect a life of from forty to fifty years . . .

The general use of modern welding methods has done much to popularize the use of steel pipe. For the last four years the Spring Valley Water Company has used a welded field joint on riveted pipe in preference to either the riveted or lead filled joint. Contrary to expectations, the heat of the welding did not open up the longitudinal riveted seam at the joint. The practice is to

(*Continued on page* 8)



WESTERN PIPE AND STEEL MAKES WATER

(1) *Pipe Bay, South San Francisco plant. Hydraulic riveting of 60-inch pipe for Hetch Hetc*
Renton Hill. Thirty-foot section of 60-inch pipe for Seattle's municipal supply. (4) *One-qu*
last rivet. Only two steps to go—pressure test and backfill. (6) *Two hundred-foot section o*
work. Wye-branch for Sacramento Valley pumping plant. (8) *From British Columbia to M*
delay W. P. & S. in laying this line.

IN ALL SIZES FROM 4 INCHES TO 14 FEET

(2) *Last word in car loading. How 30-inch riveted pipe looks on arrival at job.* (3) *Up ile laid in 8 hours. W. P. & S. field crew breaks record on Hetch Hetchy job.* (5) *Driving d pipe ready for lowering. This was soil-proofed after dipping.* (7) *For reclamation highways and byways are drained by W. P. & S. corrugated culverts.* (9) *Snow did not*

Western Pipe and Steel News
PUBLISHED BY
WESTERN PIPE AND STEEL COMPANY
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444 MARKET STREET, SAN FRANCISCO
KEARNY 4110
EDITED BY EDWARD F. O'DAY

WESTERN Pipe and Steel is cooperating actively with the City of San Francisco in the development of the great Hetch Hetchy water system. The company is playing an important part in the work of rushing to completion the so-called Bay Division of the Hetch Hetchy Aqueduct; indeed, it is way ahead of schedule on its contract.

The Bay Division extends from Irvington in Alameda County to the Crystal Springs Reservoir of Spring Valley Water Company in San Mateo County. When it is completed at the end of this year, it will be used by Spring Valley Water Company to transmit water from Calaveras Reservoir in Alameda County, to Crystal Springs. This use is by agreement with the city, and is designed to immediately increase San Francisco's daily supply of water by 24 million gallons. The urgent necessity for more water explains why work is being rushed.

This Bay Division calls for 20.7 miles of 60-inch diameter riveted steel pipe. It will be in trench all the way, except on the marshes where it will be supported on a low trestle built on piles, and over the shallow portion of San Francisco Bay, west of the navigable channel, where it will be carried on a steel bridge.

The contract for this line was awarded on competitive bidding to Western Pipe and Steel, and work was begun at the South San Francisco plant on September 1 of last year.

There are involved 17,000 tons (34,000,000 lbs.) of steel plate. Seventeen miles of this plate is seven-sixteenths of an inch thick; two miles is five-sixteenths; and one mile is three-eighths of an inch thick. The operating pressure specified is 200 lbs. to the square inch. The capacity of the line will be fifty million gallons daily. Every 30-foot section receives in the shop a 200-lb. cold water test, and this test is repeated after the pipe is in the trench.

Western Pipe and Steel has a general contract for the complete installation of this Hetch Hetchy line, handling every detail from fabrication of the pipe to backfilling the trench.

The work is now more than half completed, four months ahead of schedule. A Western Pipe and Steel field crew broke all the records for water pipe installation by laying one-quarter of a mile of this big pipe in a working day of eight hours.

That speaks volumes for the organization, the morale in plant and field, and the standard of individual skill maintained by Western Pipe and Steel.

SUCH is the orderly progress of work in the plants of the company that while a big job like this for San Francisco is proceeding, there is no delay in other work. A rancher who needs well casing does not have to wait because the City of San Francisco will brook no loss of time.

The slogan of the company might well be, "If it is made of sheet or steel plate, we can make it." And, it might well be added, "We will make it on time."

The various plants, particularly the two big plants at South San Francisco and Los Angeles, carry on without confusion or difficulty a multiplicity of jobs, from the heaviest plate work—such as penstocks of 1½-inch steel—to small pipe and fittings of galvanized sheets.

Needless to say, the company is eager to satisfy the great city of San Francisco by the manner in which it executes the Hetch Hetchy contract. But it is equally eager to satisfy all its other customers, large and small. And it is organized to satisfy them.

The picture on the cover of this issue was taken near Redwood City and shows Western Pipe & Steel installation of 60-inch riveted steel water pipe for the Bay Division of the Hetch Hetchy line.

When Asking for Estimates on Water Pipe, Send Us:

Length—State lengths along proposed line, giving length of the various diameters if they have been determined.

Head—State head of water at intake and outlet of line. If there is no head at intake, state how much lower outlet is than intake. When line is connected to pump, state make and size of pump, and speed at which it is run. On account of loss in head by friction, available head at outlet will be less than difference in elevation between the two points, and required head or pressure at outlet should be stated to determine allowable friction loss.

Grade—State grade of line in feet fall per 1,000 feet in length. Unless grade is uniform throughout total length, a profile should be furnished, so that head at various points in line may be determined.

Quantity of Water Required—Give this in cubic feet per second, gallons per minute or miner's inches.

General Plan—Map or sketch should be furnished showing proposed line, so that number and location of angles, outlets, air valves, etc., may be determined.

General Information—Information should be given regarding location of line, character of country line runs through, facilities for getting pipe from railroad to site of work, and other information bearing on proposed work.

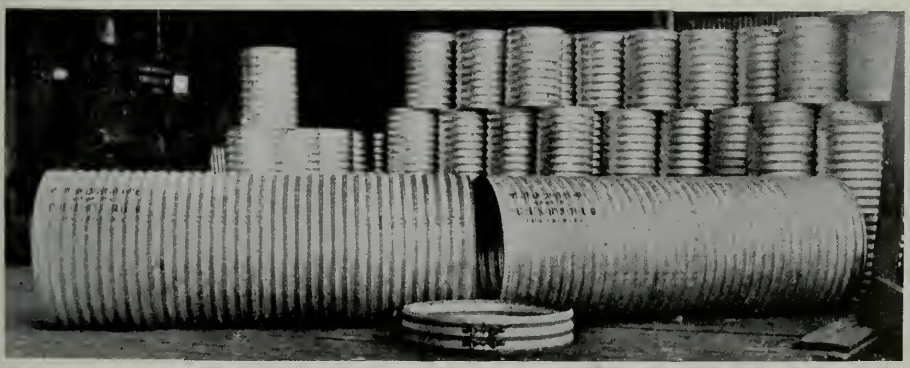
Installation—We have expert pipe layers in our employ, and prefer to send our own men to superintend installation, purchaser furnishing necessary additional labor. As conditions vary in different cases, we cannot make flat price for installation without going over proposed line, but will furnish competent man to superintend installation for agreed price per day plus expenses. In asking prices, state if installation by us is desired.

Corrugated Culverts

WESTERN Pipe and Steel specializes in the manufacture of galvanized corrugated culverts, and is constantly turning them out to fill orders for the Pacific Coast as well as for the Hawaiian and Philippine Islands. From British Columbia to Old Mexico, highways and byways are drained by these culverts.

Western Pipe and Steel culverts are made of heavily galvanized copper-bearing steel. The most exacting tests have proved this to be the best corrosion-resisting material for culverts. The copper content which is from 25 to 29 per cent, forms a true alloy with the steel, and this alloy, while having the strength of steel, gives added life and superior rust-resistance to the culverts.

The United States Government, the California Highway Commission, the large railroads and county and municipal authorities all over the Pacific Slope have long used these culverts to their complete satisfaction.



Good culverts mean long-lived roads

Steel Pipe in Water Works

(*Continued from page* 3)

weld together enough lengths to make about 200 feet of pipe on the edge of the trench, and then lower the piece into place. The number of bell holes is reduced, and the ease of working on the level ground rather than in a hole results in greater speed and reduced costs. A recent 30x$\frac{3}{16}$ inch line cost per joint for labor and material $6.00 for welding, as compared to $8.00 for a riveted joint. All of the outlets from this main were made by cutting and welding appropriate sized pieces of steel tubing to the side of the main. In a distributing system this is a great help, as at street intersections where other underground utility structures parallel the pipe, the connections were made near the top or bottom of the 30-inch main, thus enabling the branch pipe to pass over or under the obstruction without the use of bends. Not only was the welding process used for making joints and connections, but all of the bends were made in the field by the use of the same agency. To make a 90 degree elbow for instance, a piece of straight 30-inch pipe of sufficient length was taken and four wedge shaped cuts, each covering an angle of 22½ degrees were marked with chalk. These pieces were then burned out of the pipe, leaving however a small untouched strip about 2 inches long at the back of the pipe at what would be the apex of the angle, for the purpose of holding the four pieces in place. The remainder of the operation consisted of bending the pipe until the edges were in contact and welding them. The convenience of this method alone would suggest its use, but there is no doubt that taking the cost of the work as a whole, a substantial economy was effected. The pre-determination and purchase of angles, where large riveted pipe is laid in city streets, has never been satisfactory in the writer's experience, as one never knows until the trench is excavated just what artificial obstructions are to be overcome. The delay incidental to necessary changes is reduced to a minimum with a welding outfit on the job.

It may be of some interest to discuss briefly the effect of age on the carrying capacity of large plate pipes. This is a subject which has received a great deal of competent investigation. There appears to be a somewhat different experience in various parts of the country in the progressive reduction of carrying capacity. Some of the Western waters seem to produce this effect to a smaller degree than is customarily expected. Some years ago tests were made on several riveted lines in the vicinity of San Francisco to determine accurately their carrying capacity. All of these pipes had been dipped with the mixture of coal tar and asphaltum mentioned before. The results obtained are summarized in the following table.

Size Inches	Length Miles	Age Years	Williams and Hazen Value of "C"
36	21.5	23	107.5
36	6.7	23	123.0
54	3.2	8	109.0
44	5.1	27	97.9
44	4.3	27	89.1
44	5.5	13	113.5
30	7.5	42	110.0
30	5.0	4	114.0
30	1.0	46	110.0

The two instances where the value of "C" was below 100 occurred in pipes that had a large number of both horizontal and vertical bends, and in one case a piece of 37-inch diameter was necessarily included in the length tested. In general the interior of all of these pipes is in very good condition.

The oxy-acetylene torch did away with riveting in the field on this riveted steel main fabricated by W. P. & S.

Among the Customers of

Western Pipe & Steel Company

OF CALIFORNIA

Anderson-Cottonwood Irrigation District
Associated Oil Co.
Atlas Powder Co.
Bear Gulch Water Co.
California-Oregon Power Co.
Citrus Heights Irrigation District
East Bay Water Co.
Fair Oaks Irrigation District
Fresno City Water Corporation
Great Western Power Co.
Hercules Powder Co.
Lindsay-Strathmore Irrigation District
Los Alamitos Sugar Co.
Los Angeles Gas & Electric Co.
Marin Municipal Water District
Natomas Co. of California
Oakdale Irrigation District
Pacific Gas & Electric Co.
Pacific Mills Ltd.
Pelton Water Wheel Co.
Riverside Portland Cement Co.
Round Mountain Mining Co.
San Joaquin Light & Power Co.
San Jose Water Co.
Southern California Edison Co.
Spring Valley Water Co.
Standard Oil Co. of California
Sutter Basin Co.
Terra Bella Irrigation District
Turlock-Modesto Irrigation District
Union Oil Co.
Western States Gas & Electric Co.

Municipalities

Los Angeles
San Diego
Ontario
Redlands
San Bernardino
Riverside
San Francisco
Oakland
Sacramento
Santa Cruz
Seattle
Everett, Wash.

U. S. Government Departments

Bureau of Reclamation
Forestry Division
Bureau of Public Roads

Designs - Fabricates - Erects and Installs

Equipment for

Water Works
Irrigation Projects
Gas Plants
Hydro-Electric Power Plants
Oil Refineries
Canneries
Sugar Refineries
Paper Mills
Chemical Plants
Packing Houses
Ice Plants
Soap Factories
Flour Mills
Saw Mills
Mines

WESTERN PIPE AND STEEL NEWS

About Oil Storage Tanks

Western Pipe & Steel Company
OF CALIFORNIA

Designs - Fabricates - Erects - Installs
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VOLUME 1 MAY 1924 NUMBER 2

Western Pipe & Steel Builds World's Largest Oil Storage Tanks

By L. D. JURS, *Chief Engineer*
Associated Oil Company

PROBABLY nowhere in the world at any time, has the oil industry been called upon to build such immense quantities of oil storage in so short a time as was the case in the Los Angeles oil fields and Harbor district during the flush production of 1923. Upwards of 40 million barrels in steel tanks and reservoirs were constructed, of which about 5 million barrels were adjacent to Los Angeles Harbor to facilitate rapid loading and dispatch of oil tankers to the East coast and Pacific coast refiners.

This was the first time in the history of the oil industry in California that continued deliveries of crude refining petroleum were made east of the Rocky Mountains, due to the tremendous over-production of oil brought in in a short period of time.

The building of necessary tankage was accomplished during this period in spite of strikes, embargoes, and the necessity of shipping plates for fabrication from the Eastern mills.

Naturally, in a development of this kind, all of the leading tank builders in the country were anxious to get their share of this business, and on this account competition was keen with the result that many speed records were broken and new and economical ways of erection perfected. Most of the tankage built was in units of 80,000 barrels, this size having almost entirely supplanted the former standard size of 55,000 barrels capacity. The change had been brought about through improved fabrication and construction and elimination of fire hazard by replacing the old type wood and prepared paper roofing with all-steel, gas-tight, conical, depressed waterseal roofs; also through better knowledge on the part of all concerned of the losses incurred in storing and handling light crude oils, as well as recognition of the importance of properly protecting the steel bottom and ring plates with carefully selected protective coatings and paint.

Experience has shown that steel tanks properly built for oil have a comparatively long life, with the exception that, due to oil conditions, this life is predicated on the condition of the bottom plates of the tank. In recent years the first storage tanks built on the Pacific Coast have, to a considerable extent, been dismantled and rebuilt to allow for placing new bottom plates. The life of these bottom plates can be materially increased by proper care in cleaning and in applying suitable protective paints to the metal.

In carrying out such programs of storage as were required, the various oil

companies were compelled to purchase large tracts of land adjacent to pipe lines, producing fields and shipping facilities. The producing wells in these new fields —many of them on town lots—being drilled too close together to allow space for more than an ordinary 500 to 5000-barrel field run tank, and available land being situated in or adjacent to large cities or rich agricultural or citrus lands, such land naturally commanded a high price at the outset, and as requirements grew and large areas became scarce, the prices asked by owners doubled and trebled in a few weeks. In some cases very large tracts of land were withdrawn from the market, presumably because the owners believed all such land was capable of producing oil, so that by the spring of 1923 prices were beyond all reason.

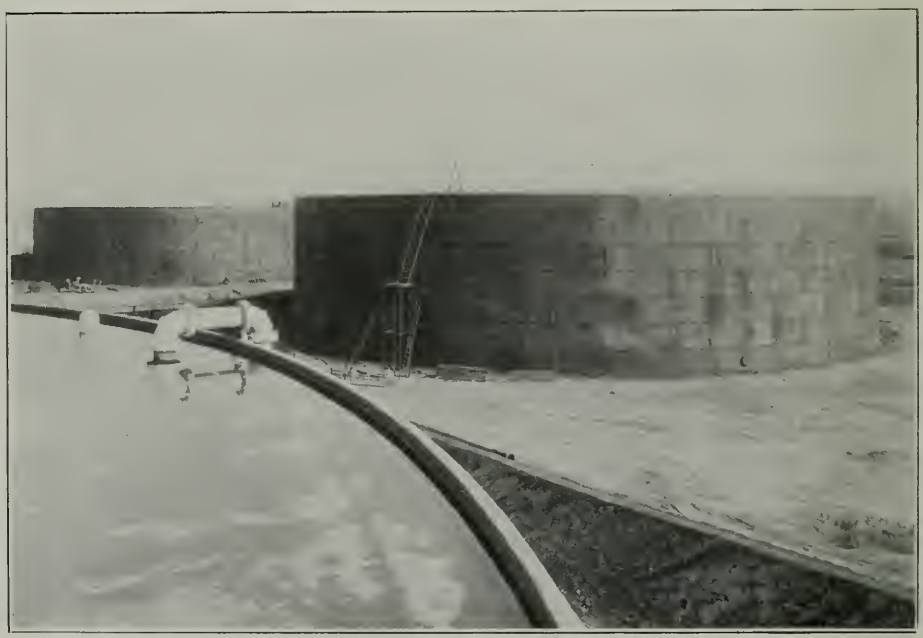
Thus producing and marketing companies were forced to cut down their storage per acre to a minimum consistent with a reasonable fire and loss risk, and in some cases were forced to ignore these considerations altogether.

Numerous earthen reservoirs, lined with concrete and with roofs made as tight as possible to minimize evaporation, were built and utilized for the first time in the oil industry for storing light oil, but such reservoirs can be built only on selected ground where the natural material is suitable for the construction of solid embankments. Little land of this character was available as feasible storage sites.

Faced with these problems, and requiring a million barrels of storage on a given area of ground at the Associated Oil Co.'s Watson tank farm, six miles from Los Angeles Harbor, the company's engineers, after considering a safe spacing between tanks, conceived the idea of building still larger tanks than the then standard 80,000-barrel size, and for this particular requirement fixed on a size between 175,000 and 180,000 barrels capacity each.

After it had been ascertained that the steel plates required could be produced in a short time, Western Pipe & Steel Company was called upon to assist in

(*Continued on page* 8)



A close-up of some of the 178,000-*barrel oil storage tanks erected by W. P. & S. for Associated Oil Co. at Watson Tank Farm. Waterseal roof in foreground.*

Electric Welding New Bottoms in Old Tanks

ENGINEERING research and investigation are continually opening new fields and suggesting new application of old methods of scientific procedure. In no industry is there a better illustration of this than the petroleum, and an interesting example is the adaptation of the process of autogenous welding of bottoms and roofs of large oil storage tanks.

For several years the engineering department of Western Pipe & Steel carried on experiments in electric welding. The plants were equipped with every facility for carrying on exhaustive tests, the apparatus including practically every make of welding equipment such as hand, semi-automatic and automatic machines, resistance welders, automatic metallic electrode welders, and automatic carbon electrode welders.

With the cooperation and help of L. F. Champion, Chief Engineer of Pacific Oil Co., our engineers have worked out a method of replacing bottoms of large oil storage tanks without the expense of raising the tank or disturbing the roof.

A new bottom was recently installed in Pacific Oil Co.'s tank No. 64 at Taft. The tank, which is 55,000-barrel capacity, is about ten years old. When it was emptied the original bottom plates, which were $\frac{3}{16}''$ in thickness, were found eaten away by acids in the oil, so that in some places there was barely $\frac{1}{16}''$ of metal left. The bottom angle was badly pitted and some of the bottom angle rivet heads had been entirely eaten away.

First a new concrete foundation was put in to replace the oiled sand foundation. The concrete was placed in sections to avoid disturbing the tank and roof supports. New bottom plates were dragged through the door sheet and put in place, being laid with a 1¼″ lap. After the bottom was covered by rectangular plates, the sketch plates were fitted to the bottom angle with the acetylen cutting torch. The bottom plates were ¼″x72″x192″.

Plates were tacked in place with a 1″ tack every twelve inches. The tacking was done by one man, using a General Electric W. D. 9 welder. Following the tacker was the man who did the actual welding, using a W. D. 10 gasoline driven outfit with portable semi-automatic attachment. All welds on the botton rectangular plates were heavy lap fillet welds.

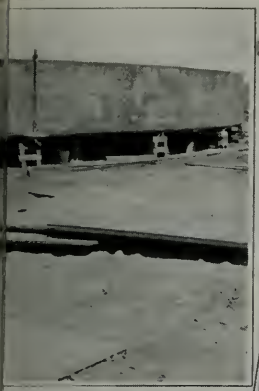
Upon completion the tank was tested by building a twelve-inch dyke around it, and forcing 30 gravity crude oil between the tank bottom and the concrete foundation until the oil level in the dyke stood at six inches. This was a most severe test, as such high gravity oil leaks through openings almost microscopic.

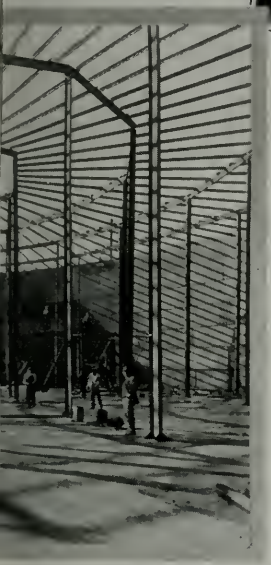
The oil was kept at this level for a period of twelve hours, to test the angle rivets for leaks which might have been due to the welding heat. After the 12-hour test the tank was accepted by Pacific Oil Co. and immediately filled to capacity with crude oil. The tank has now been in service about two months and no signs of leakage have appeared.

New electric welded bottom in 10-year-old tank at Taft

Progress pictures taken while Western Pipe & Steel was building world's largest oil storage tanks near Los Angeles. Upper left—Bottom in place, first course started. Upper center—View showing specially constructed air-operated yoke riveter in action. Upper right—Lowering bottom with powerful hydraulic jacks. As cribbing was removed these jacks lowered the bottom five inches at a time.

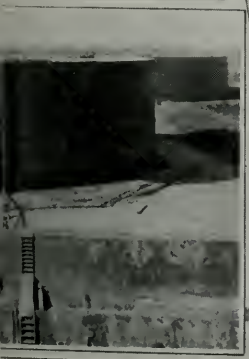
Interior view showing
Bottom area of tank is
nearly three

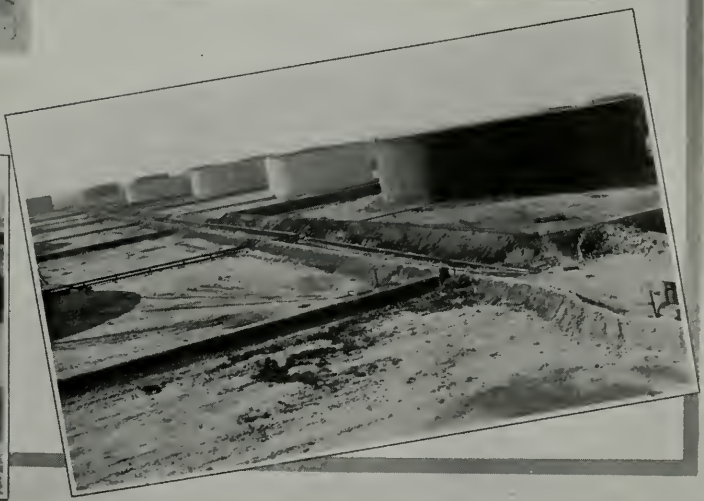




Lower left—One of the giant tanks completed, its neighbor with bottom and first ring finished and resting on cribbing ready to be lowered. Lower center—As the big containers appeared when turned over to Associated Oil Co. Lower right—General view at Watson Tank Farm, contrasting the big tank (at right of picture) with 80,000-barrel tanks (painted white)

of the big tanks.
000 square feet, or
n acre.





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444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

THE year 1923 was a great year in the history of the California petroleum industry. More than that, it was a great year in the history of Western Pipe & Steel, for the spectacular flush production of the period enabled this company to demonstrate that it has the organization and equipment to meet such an emergency and to acquit itself with distinction. Not only did the company meet every demand made upon its facilities for enormous tankage, and for extraordinary quantities of refinery equipment, but each of its plants continued to handle, without upset or delay, regular work in all of our varied lines.

Thus the departments which manufacture riveted steel water pipe, irrigation pipe, well casing, corrugated culverts, galvanized tanks, bolted steel tanks, pressure and gravity tanks, general plate work, and a dozen other lines, continued throughout this strenuous period to function normally, serving the wants of all customers with satisfaction.

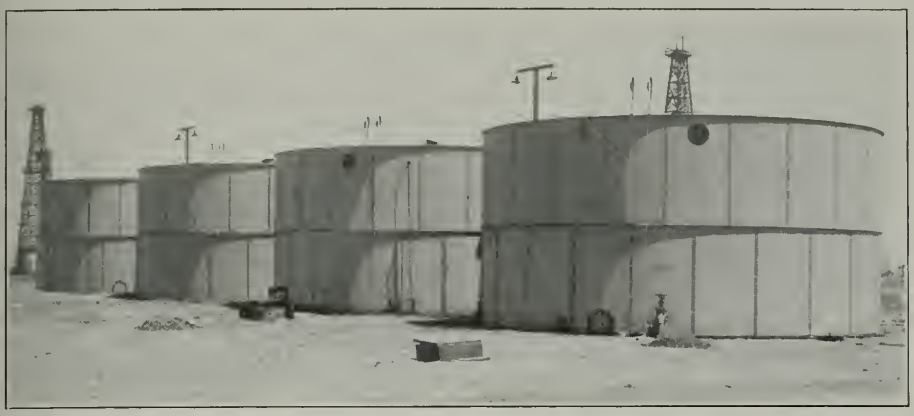
Of oil storage tanks in large units alone, Western Pipe & Steel built, during California's year of flush production, a total of ten million barrels capacity. Of this stupendous total, seven and one-half million barrels were constructed in the Los Angeles district, represented in 92 tanks. At the same time these big tanks were being built, small tanks of every size, from 50 gallons up, were turned out.

There are two major reasons—aside from consideration of equipment, organization, morale, experience and management—that account for Western Pipe & Steel's ability to take on orders for heavy construction work of great magnitude and at the same time carry on as usual.

First—Advantageous location of its plants at Los Angeles, Taft, Fresno and San Francisco. Having plants at these strategic points in the State enables us to cover the field exceptionally well.

Second — Western Pipe & Steel's policy of carrying heavy stocks of material at all its plants, which policy enables it, as a rule, to fill practically any order from material in stock.

Typical battery of distributing station tanks manufactured by Western Pipe & Steel



Battery of 2500-barrel bolted tanks built for Sentinel Oil Co. near Los Angeles

W. P. & S. Bolted Tanks Lead in the West

ONE of the things in which Western Pipe & Steel takes a pardonable pride is that having grown up with the California petroleum industry, it has been the privilege of men in this organization to cooperate in the solution of many of the problems which have confronted that industry during various stages of its growth. The sum of our experience, and our engineering skill and manufacturing resources are always at the service of those who have problems to solve.

A few years ago the oil industry began to feel the need of small capacity storage tanks which would embody the threefold advantage of quick, easy and economical erection in the field; a certain flexibility in size so that capacity could be quickly increased by the simple expedient of adding another course; and so constructed as to be easily dismantled and moved to a new location if necessary, as frequently happens.

Western Pipe & Steel bolted steel tanks met that demand. So popular has this type of container become that the bolted tank department of our various plants has frequently been taxed to supply the requirements of the oil industry. Bolted tanks are now designed and built by Western Pipe & Steel in sizes ranging from 100 barrels to 10,000 barrels. As to size-flexibility of bolted tanks, it will interest readers to know, by way of example, that a 1000-barrel tank can be converted into a 2000-barrel tank by the addition of one course.

To insure maximum rust resistance and long life, Keystone copper steel is used exclusively in Western Pipe & Steel bolted tanks, and we use only specially prepared gaskets and cement which experience has proved to be the best insurance against leaks.

Bolted steel tanks are made with either cone or waterseal roof, and our plants are equipped to give quick and efficient service in their fabrication and erection. It is our policy to carry a considerable stock on hand so that there is no delay in manufacturing occasioned by waiting for material. Work of this kind is usually wanted just as quickly as it can be turned out, so our stock is maintained with a view to quick deliveries.

The bolted tank being our exclusive contribution to the oil industry of the West, our field service naturally plays a very important part in erection. We regard such work not merely as "another tank" but as another opportunity for Western Pipe & Steel to give the finest bolted tank storage possible.

Ours are the only bolted tanks made in California for the California industry.

Largest Oil Storage Tanks

(*Continued from page* 2)

designing and planning methods of construction for the job. Accepting the responsibility involved in the proposed radical departure from standard practices in tank construction, Western Pipe & Steel Company was given orders immediately for six tanks of 178,000 barrels capacity each, on early guarantee delivery promises.

These tanks are believed to be the largest oil storage tanks in the world. They are 175′ 9″ in diameter, by 41′ 6½″ high, and 720 tons of steel were used in each tank. However, before the completion of all six tanks, oil production in Southern California from the new major fields was dropping so rapidly that only five of the big tanks were erected at the Watson tank farm. The sixth was moved to the Associated Oil Co.'s refinery at Avon—on San Francisco Bay, and erected there.

The tanks, when tested with light crude oil upon completion, were freer from shell leaks than any oil tanks I have even seen, and were in perfect shape and form during filling and emptying periods. Much credit is due Western Pipe & Steel Company for the manner in which these tanks were designed, fabricated and erected.

While it is thought that, under present conditions and costs, 80,000-barrel tanks are at about the limit of economical cost per barrel, consideration must be given to economy in such factors as smaller land area required for tank farms, greater spacing obtained between shells of tanks in limited areas, shorter connecting pipe lines required, and fewer fittings, valves, and appurtenances per barrel stored. It should also be considered that there is required less grading and levee work for foundations, and protection to adjoining properties and tanks.

In connection with the 178,000-barrel tanks built by Western Pipe & Steel, we found that a given storage of the larger tanks required 55% less land than if 80,000-barrel standard tanks were used, with an equal spacing of tanks from shell to shell.

Just as larger shops, larger buildings, gas holders, and structures in all industries are being built, so will larger tanks be constructed, with absolute safety. The limit of size will be regulated only by considerations of economy of construction, limitation of field equipment, and ability to obtain plates of the required thickness and size. From inquiries received, and from personal observation, it is apparent that keen interest in large tanks has been aroused, and a demand for them created in many sections of the country. Even the U. S. Government has taken an interest in the subject.

In the field erection of the 178,000-barrel tanks by Western Pipe & Steel, the steel plates, after being delivered by truck to the tank site, were dragged to their approximate positions by tractors and lifted and bolted into place by a caterpillar locomotive crane, so that but little time and effort were required in getting ready for riveting.

It was necessary in fitting up to use acetylen gas torches on the heavier plates and butt straps, to heat the metal for laying up the joints. On account of the size of rivets used, the riveting on the shell plates was done almost entirely by specially constructed air-operated yoke riveters.

The uncertainty of lowering the heavy bottom successfully in the conventional way was finally overcome, and the bottoms were lowered in a few hours time without mishap by the use of cribbing and 8 hydraulic jacks of 15 tons capacity each, placed around the bottom angle and plate.

The summary on the opposite page shows by comparison the principal differences between the standard 80,000-barrel tank, and the new 178,000 barrel size.

The cover of this issue was made from an airplane photograph of Associated Oil Co.'s tank farm at Watson, Cal., near Los Angeles. Five of the 178,000-*barrel tanks built by Western Pipe & Steel are seen in the center of the picture.*

Western Pipe and Steel

Comparative Specifications of 80,000 Barrel and 178,000 Barrel Steel Tanks with Water Seal Roofs.

	80,000 Bbl.	178,000 Bbl.
Approximate Wt.	300 Tons	720 Tons
Diameter	117′ 2″	175′ 9″
Height	41′ 0″	41′ 6½″
First Course		
Plates	⅝″—25.5 #	1″—40.8 #
Vertical Joint	Double butt strap joint Quadruple riveted with ⅞″ rivets	Double butt strap joint Sextuple riveted with 1⅛″ rivets
Second Course		
Plates	17/32″—21.67 #	⅞″—35.7 #
Vertical Joint	Double butt strap joint Quadruple riveted with ¾″ rivets	Double butt strap joint Quintuple riveted with 1″ rivets
Third Course		
Plates	½″—20.4 #	23/32″—29.32 #
Vertical Joint	Lap joint Quadruple riveted with ¾″ rivets	Double butt strap joint Quadruple riveted with 1″ rivets
Fourth Course		
Plates	7/16″—17.85 #	19/32″—24.22 #
Vertical Joint	Lap joint Triple riveted with ¾″ rivets	Double butt strap joint Quadruple riveted with ⅞″ rivets
Fifth Course		
Plates	5/16″—12.75 #	7/16″—17.85 #
Vertical Joint	Lap joint Triple riveted with ⅝″ rivets	Double butt strap joint Quadruple riveted with ¾″ rivets
Sixth Course		
Plates	¼″—11 #	⅜″—15.3 #
Vertical Joint	Lap joint Double riveted with ½″ rivets	Lap joint Triple riveted with ⅝″ rivets
Seventh Course		
Plates	13/64″—8.29 #	¼″—10.2 #
Vertical Joint	Lap joint Double riveted with ⅜″ rivets	Lap joint Double riveted with ½″ rivets
Bottom Angle	4 x 4 x ⅝	6 x 6 x ¾
Top Angle	3 x 3 x ⅜	3 x 3 x ⅜
Bottom		
Rectangular Plates	13/64″—8.29 #	5/16″—12.75 #
Sketch Plates	¼″—10.2 #	⅜″—15.3 #
Roof		
Rectangular Plates	3/16″—7.65 #	3/16″—7.65 #
Sketch Plates		¼″—10.2 #

Has Designed-Fabricated-Erected
Oil Storage Tanks for

Associated Oil Co.
Chanslor-Canfield Midway Oil Co.
Export Refining Co.
General Petroleum Co.
Hercules Gasoline Co.
Honolulu Consolidated Oil Co.
Mohawk Oil Co.
North American Oil Consolidated
Pan-American Petroleum Transport Co.
Petroleum Midway Oil Co.
Richfield Oil Co.
Shell Co. of California
Standard Oil Co. of California
Superior Oil Co.
Union Oil Co. of California
United Oil Co.
Western Refining Co.
Wilshire Oil Co.

WESTERN PIPE AND STEEL NEWS

Santa Cruz—1852-1924

Seventy-two years ago, this was the business center of Santa Cruz. It is an important junction today, as the lower picture shows, but business flows steadily oceanward along beautiful, lively Pacific Avenue. Nobody dreamed in 1852 that Santa Cruz would become famous as a great playground of the West, with a population of 15,000. These contrasting pictures are presented through the courtesy of Superior Judge H. C. Lucas and Secretary-Manager Leslie Cranbourne of the Santa Cruz Chamber of Commerce.

WESTERN PIPE *and* STEEL NEWS

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME 1 JUNE-JULY, 1924 NUMBER 3

How the City of Santa Cruz Is Meeting Its Water Problem

Santa Cruz is a popular seaside resort. The site of the city, which spreads back over bluffs and terraces to the foothills of the mountains (2000-3800 *feet in altitude), is very picturesque, and the scenery in the environs beautiful. Hills nearly enclose the city, protecting it from the ocean fogs. Monterey Bay has a remarkable variety of fish, and there is a large fish hatchery near the city. Fruits in great variety are grown in the valley and foothills. The mountains are covered with one of the noblest redwood forests of the State—the only one south of San Francisco.*—From the *Encyclopedia Britannica.*

THE City of Santa Cruz, in common with most other prosperous Pacific Coast municipalities, found itself confronted with the water problem that arises from growth of population and the resultant increase in industrial and domestic consumption.

Facing the urgent necessity of adding to its water supply, not only because of a 200 per cent increase in population in the last 24 years and 50 per cent in the last four years, (5,659 in 1900, 11,146 in 1910, 10,917 in 1920, and now estimated at 15,000) but also to provide for future growth, Santa Cruz decided to augment its water supply in three ways.

First—By building a pipe line to replace the old flume from the source in Major's Creek Canyon, and a new 22-inch line to deliver the combined flow from Major's Creek, Laguna Creek and Liddell Springs into the new Bay Street Reservoir. This will add one million gallons per day to the capacity of the present system.

Second—By constructing the Bay Street Reservoir of 31,000,000 gallons capacity.

Third—By installing new pumping equipment at San Lorenzo River, which will add another 1,000,000 gallons to the daily supply.

The contract for furnishing and installing 30,200 feet of double riveted, double dipped steel water pipe required for the first item in the program was awarded to Western Pipe & Steel. The company started the job in April and completed it in June.

The purpose of this article is to tell how the job was carried out successfully and on time, in the face of innumerable handicaps, including a difficult terrain, unusual problems in transportation, heavy grades, and the necessity of keeping water running through the Major's Creek Canyon line while tearing out the old wooden flume and replacing it with steel pipe.

Our further purpose is to show other municipalities that no matter how difficult the problem it can always be solved, and that no matter what obstacles present themselves Western Pipe & Steel service can be depended on to deliver the goods on time and up to specifications.

The first element in this interesting job was the replacement of the ancient wooden flume of the Major's Creek Canyon line with 14-inch steel pipe, and

then paralleling the pipe line from Laguna Creek and Liddell Springs to a point 9,200 feet from the new Bay Street Reservoir where the two lines merge.

The second element was the installation of 9,200 feet of 22-inch steel pipe from the junction mentioned, into the Bay Street Reservoir.

Liddell Springs has a capacity of about 1,000,000 gallons per day, Laguna Creek about 2,500,000 gallons, and Major's Creek about 700,000 gallons per day, giving a total of about 4,250,000 gallons per day. At the present time Santa Cruz has an average daily consumption of 2,500,000 to 3,000,000 gallons with a peak consumption of 4,000,000 gallons. This peak is reached at the seasonal periods when plant bulbs, berries and Santa Cruz's famous chicken industry are at the height of their requirements.

Liddell Springs is piped where it breaks from the mountain side. Laguna and Major's Creeks have their origin high in the Coast Range which is heavily timbered, and they are therefore reliable in the amounts given. To replace a like footage of old wooden flume on the Major's Creek line, 4,800 feet of double-riveted steel soil-proofed pipe, 14 inches in diameter and of No. 12 gauge steel, was used. There had been a loss of well over 50 per cent of the available supply from this source because the wooden flume leaked. With the new steel pipe in place, this loss has been entirely overcome, and for the first time in its history, Santa Cruz is realizing 100 per cent from that source.

This pipe, running on the low grade of the old flume, was necessarily large. At the termination of the flume line, the 14-inch pipe continues through 300 feet of tunnel to a point where the grade breaks, when it connects to 10-inch (12 gauge) slip joint soil proof steel pipe which runs for 2,000 feet. Thence, because of increased pressure, the 10-inch line for 600 feet has welded joints.

From this point, with pressure again increased, the 10-inch pipe is increased to No. 10 gauge and continues for 13,600 feet, paralleling the old 14-inch line coming from Laguna Creek and Liddell Springs into the Cowell reservoir.

These two lines, 10-inch and 14-inch, are then joined in a 22-inch line which carries their combined capacity into the new Bay Street reservoir.

The entire new line is designed to withstand the pressure from the highest point in the city's sources of supply, which is Laguna Creek. It is all soil-proofed double riveted steel. Under lighter pressure the slip joint was used, while under heavy pressure lap-welded joints were ordered. This was a measure of extra precaution as slip joints could have been used throughout with perfect assurance of efficiency.

Automatic air valves were installed on every elevation of the line where air pockets might form. Blow-offs were installed at every pronounced depression in order to properly drain the pipe in case of necessity.

Hauling pipe over some of Santa Cruz's most beautiful and rugged scenery was one of the difficulties encountered. The pipe was shipped to the nearest station where it could be side-tracked. The maximum haul from the

(*Continued on page* 8)

Installing last section, Santa Cruz line. Filled trench on distant hillside.

Something New—Steel Tunnel Lagging

By T. H. Carver, *Water Supply Engineer*
City of Seattle

ENGINEERS will be quick to perceive that the picture below tells an important story. It is the story of pressed steel lagging or forms, and every man who ever has been, is now, or expects to be interested in tunnel work will want the details. Hence this article.

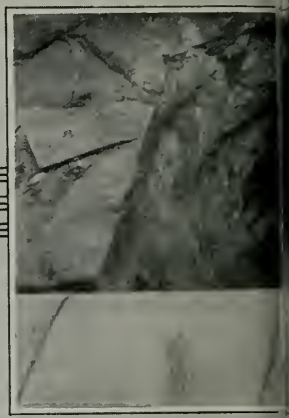
The City of Seattle is constructing, as an important link in its water supply system, a two-mile tunnel outlet from Lake Youngs reservoir, about twenty-two miles southeast of the city. The tunnel contract was placed with Jahn & Bressi. As a measure of economy in construction, it was decided to use pressed steel lagging which, although never used on the Pacific Coast before to my knowledge, is obviously adapted to use in soft ground and where a circular tunnel is being driven.

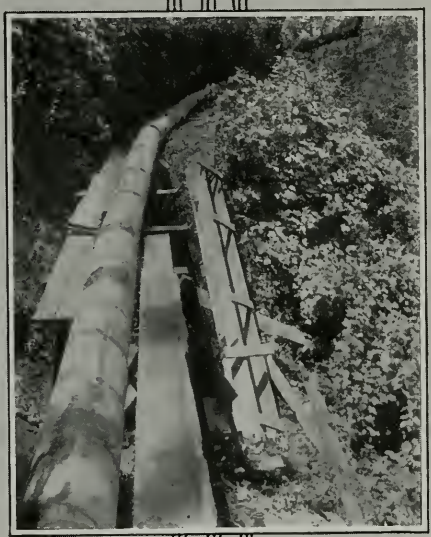
As compared to the cost of old-fashioned timber lagging with square framed sets and paling boards, the greatest saving is, of course, in the very much reduced volume of excavation. On the Seattle tunnel this saving in excavation volume is 44 per cent. In other words, if the tunnel was driven with timber lagging, excavation would be 5½ cubic yards per foot. With pressed steel lagging, the excavation is only 3-1/10 yards per foot.

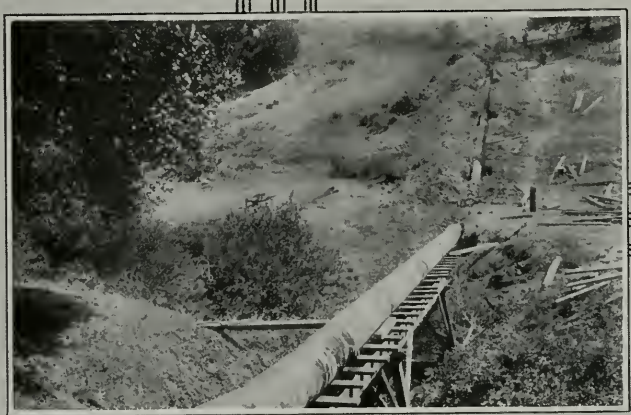
The contract for steel lagging was placed with Western Pipe & Steel, as, fortunately, owing to their wide range of equipment, they had the necessary large presses in their Los Angeles plant especially adapted to this class of work, and could begin manufacture immediately. Each unit weighs 20 pounds,

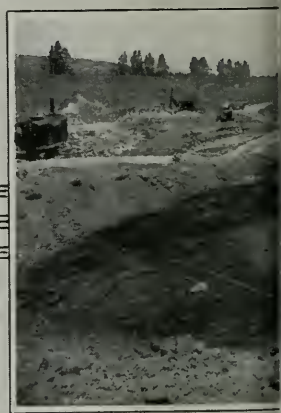
(*Continued on page* 8)

Seattle tunnel, showing W. P. & S. steel lagging in place. This is first use of steel forms in tunnel work on Pacific Coast.

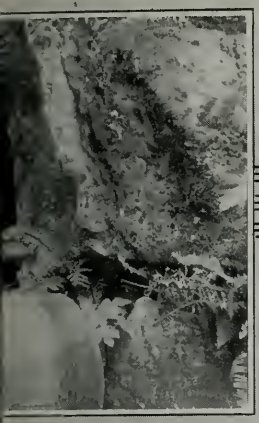


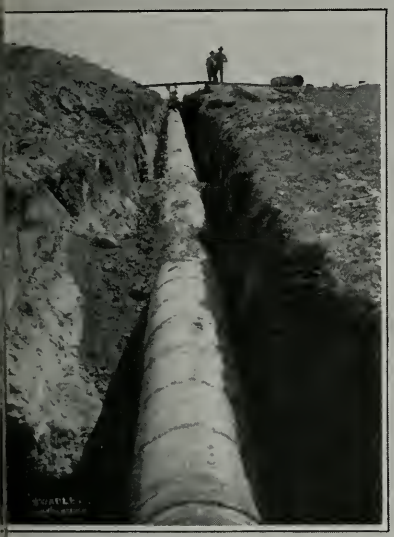


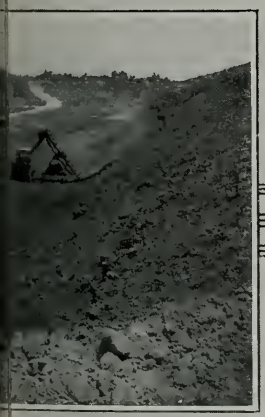




WESTERN PIPE & STEEL INSTALLATION OF PIPE LINE FOR SANTA CRI
double dipped steel water pipe.—A 300′ tunnel through rock, Majors Creek Canyon.— Pip
Center (left to right)—As fast as joints were welded the pipe line was cut in and the wo
place in Majors Creek Canyon line.—A part of the 22″ pipe line was laid on a 45% grad
right)—Across a ravine and over the hill by trestle and trench. The distant sidehill gr
Tanks manufactured by W. P. & S. and installed by California Filter Co.







(left to right)—Crossing a ravine on trestle over creek bed, with 22" double riveted, g face of cliff, showing old wooden flume which W. P. & S. steel pipe is displacing. discarded without interruption to flow of water.—Rolling pipe section along trestle to its er this hill.—Welding a joint in the trench with oxy-acetylene torch. Lower (left to .—Santa Cruz Bay street reservoir in the making.—New Santa Cruz filtration plant.

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"FOR all our resources," said an ancient writer, "the earth is indebted to the bounteousness of water." There is no more helpful sign in Pacific Coast life today than the fact that every community is alive to "the bounteousness of water" and to the necessity of impounding it in abundance.

Santa Cruz is a conspicuous example. It is not only enhancing its water supply to meet present needs, but is also looking ahead to the demands that will be made by the thousands destined to find in this charming community "the somewhere of their dreams."

The pipe line part of the Santa Cruz program has been completed—and on time—by Western Pipe & Steel. The pictures in this issue show some of the difficulties of the job. The cover picture, in particular, tells a story of obstacles overcome. It takes bold experts to install pipe along a canyon wall, lowering it over an almost perpendicular cliff. In the cover picture the Western Pipe & Steel men are doing precisely that thing.

Western Pipe & Steel, however, is organized to do the job, no matter how difficult. It has manufactured and installed pipe for municipal systems like Los Angeles and Seattle, for Spring Valley in San Francisco and East Bay Water in Oakland, as well as for cities like San Diego, Ontario, Redlands, San Bernardino, Riverside, Sacramento, Everett (Wash.) and Santa Cruz.

Western Pipe & Steel and the Companies merged with our organization are pioneer manufacturers of double riveted and double dipped steel water pipe. Pipe lines installed as far back as 1880 are still giving satisfactory service.

Western Pipe & Steel has been continuously manufacturing pipe for municipalities, water companies, irrigation districts, mining companies and ranches. Our facilities are of the very best. We have exceptionally well equipped plants at Los Angeles and San Francisco with a combined capacity of nearly a mile of pipe a day. Although standard double riveted and double dipped water pipe is usually thought of as pipe from 16 to 10 gauge, we are now equipped to manufacture pipe from 10 gauge to heavy penstock work requiring material as heavy as 1¼-inch boiler plate.

To name one reason for Western Pipe & Steel success in such work: We study the water problem from the viewpoint of the city's best interests. Our engineers are at the service of the community. All our staff cooperates whole-heartedly with the local engineers and superintendents. Our work is not finished until they are satisfied.

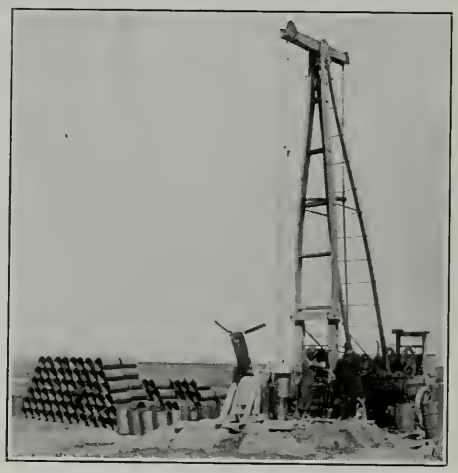
Lowering a 200′ welded section of 22″ riveted steel water pipe made by W. P. & S. for Spring Valley Water Company, San Francisco.

Why W. P. & S. Well Casing Is Best

THIS organization has been making well casing so many years, and so successfully, that it has come to be second nature to us to feel that we excel in this line.

Western Pipe & Steel well casing is made of the best quality of hard red steel; each joint is lathe trimmed and each joint fitted in the shop to assure perfect fit and alignment in the field. Large stocks of material are carried on hand to manufacture casing in any gauge required and in 24-inch joints for No. 16 or 14 gauge and either 24-inch or 36-inch joints in No. 12, 10 or 8 gauge to suit requirements. Made in any diameter from 4 inches to 36 inches in both single and double and in sections when so required, well casing in any quantity can be furnished on short notice.

All of our plants are equipped to fill orders promptly, and shipments are made from the plant nearest the customer to give him the benefit of the lowest possible freight rate.



W. P. & S. well casing. The picture was taken near Fresno.

W. P. & S. 20" riveted steel pipe in residence district mains, Berkeley, for East Bay Water Company. Service connections are welded to steel mains.

Santa Cruz

(*Continued from page* 2)

railroad by motor truck to the field was six miles over heavy grades, as much as 15 and even 20 per cent in places. Some of the 22-inch pipe was laid on a 45 per cent grade. In places it was necessary to lower the sections as much as 200 feet down the face of the canyon wall. To do this with safety and despatch, sections were made short, four, eight and twelve feet long, whereas the other sections were made 30 feet long.

Annapolis P. Marine, ("Nap" is the oldest pipe-layer in the field today), who has helped lay hundreds of miles of pipe for Western Pipe & Steel, has stated vehemently that in all his experience he never knew such a job as this.

Under apparently insuperable difficulties, the injunction to keep water flowing through the Major's Creek Canyon line was carried out. When a sizable unit of the pipe was ready, the water was cut off, the wooden flume was thrown aside and the pipe line welded. Water was then connected again and the flow maintained until the next cut-in. At one time 1,200 feet of pipe was cut in in less than three hours.

Late in May 11,000 feet of the 10-inch pipe was tested, and no leaks developed. On June 14th, the entire job was completed (except the connection into Bay Street reservoir, which must await completion) and Major's Creek water turned in as a test for leaks. A few days later pressure tests were made by turning in also the water from Cowell reservoir. After a few minor check ups, the job was finished and accepted.

This Santa Cruz job was a perfect demonstration of the advantages of Western Pipe & Steel riveted water pipe, the triple qualities of its light weight, strength, and durability proving again and again the wisdom of its selection. The strength and durability of this type of pipe are of course, known factors, the double riveting and double dipping giving double assurance of these qualities. As to the merits of light weight, it takes work in difficult terrain just such as this job presented to show its great economy.

Light weight meant greater convenience and economy in hauling pipe to difficult locations and also in installing in the canyon and over the steep grades. Heavier pipe would not only have been very difficult to handle, but would have added enormously to the expense.

Western Pipe & Steel Santa Cruz pipe line is a monument to double riveted, double dipped steel pipe.

Steel Tunnel Lagging

(*Continued from page* 3)

and No. 12 gauge sheets are used. They are turning 1,100 tons of this material into 110,000 segments for this tunnel work. The tunnel job was started some 60 days ago and will be completed October 1, 1925.

The diameter of the hole is 10 feet 4 inches. As the tunnel will be lined with concrete 14 inches thick, the inside diameter will be eight feet. This gives a carrying capacity of 150,000,000 gallons of water per day.

The picture accompanying this article shows how the steel lagging appears in place. I would like to say here that the segments are easily handled by the workmen, and when bolted up into a complete ring, make a very strong and rigid support. The units are pressed with a flange on four sides, through which they are bolted together, the joints alternating, as shown in the picture, four bolts on each side, and three bolts at each end. To make the lagging solid against the earth, grout will be pumped around it.

From the interest already manifested by engineers and contractors and municipal officials, as well as representatives of private enterprise, the Seattle tunnel will be one of the centers of interest on the Pacific Coast for a long time to come. In fact, we look forward with a great deal of anticipatory pleasure, to the privilege of welcoming those interested, who wish to inspect at first hand this new type of tunnel construction. Although it has been quite extensively used in the East, to Western Pipe & Steel has fallen the honor of initiating pressed steel tunnel lagging in the West.

Among the Customers of

Western Pipe & Steel Company

OF CALIFORNIA

Municipalities

Los Angeles
San Diego
Ontario
Redlands
San Bernardino
Riverside
San Francisco
Oakland
Sacramento
Santa Cruz
Seattle
Everett, Wash.

Anderson-Cottonwood Irrigation District
Associated Oil Co.
Atlas Powder Co.
Bear Gulch Water Co.
California-Oregon Power Co.
Citrus Heights Irrigation District
East Bay Water Co.
Fair Oaks Irrigation District
Fresno City Water Corporation
Great Western Power Co.
Hercules Powder Co.
Lindsay-Strathmore Irrigation District
Los Alamitos Sugar Co.
Los Angeles Gas & Electric Co.
Marin Municipal Water District
Natomas Co. of California
Oakdale Irrigation District
Pacific Gas & Electric Co.
Pacific Mills Ltd.
Pelton Water Wheel Co.
Riverside Portland Cement Co.
Round Mountain Mining Co.
San Joaquin Light & Power Co.
San Jose Water Co.
Southern California Edison Co.
Spring Valley Water Co.
Standard Oil Co. of California
Sutter Basin Co.
Terra Bella Irrigation District
Turlock-Modesto Irrigation District
Union Oil Co.
Western States Gas & Electric Co.

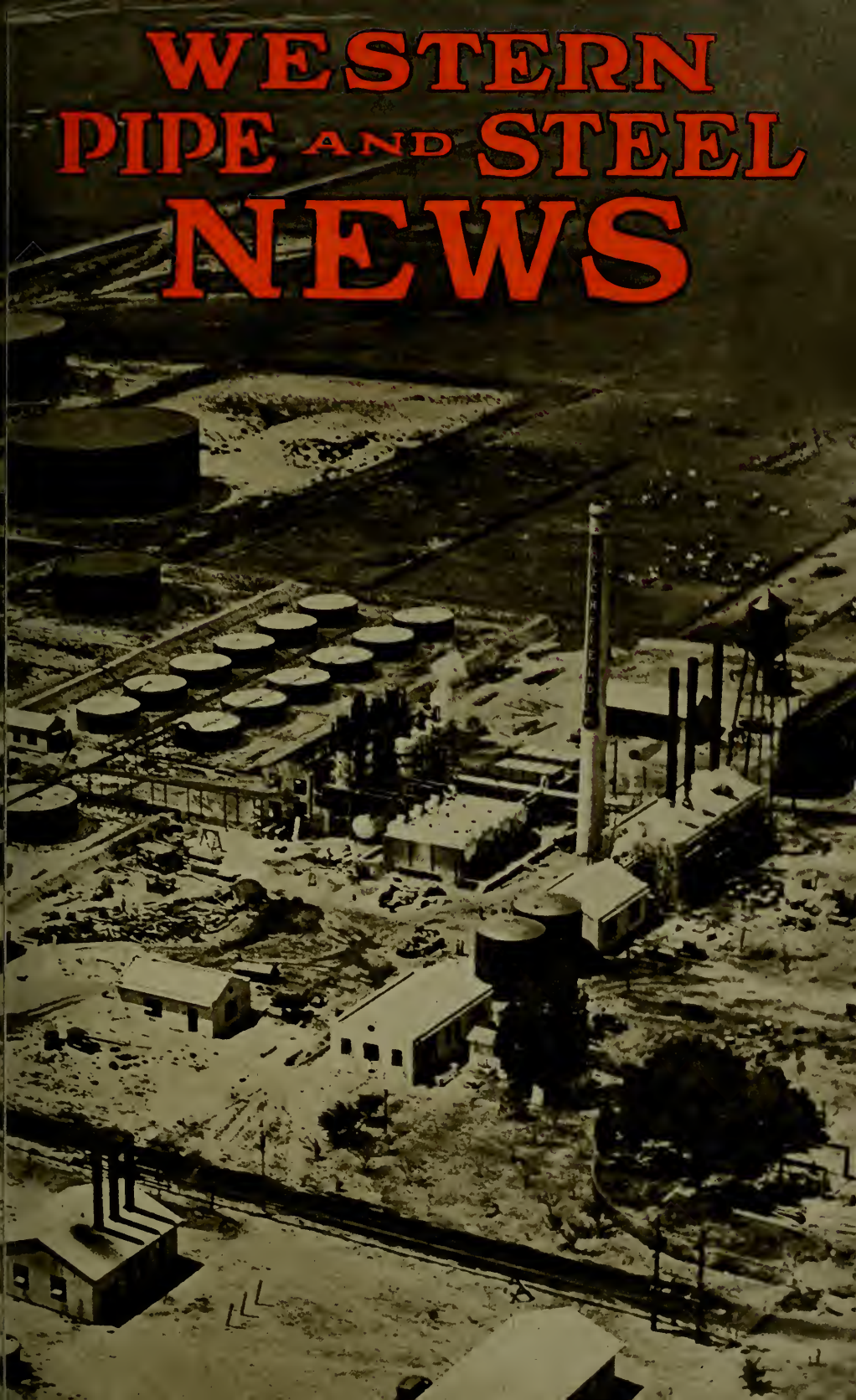
U. S. Government Departments

Bureau of Reclamation
Forestry Division
Bureau of Public Roads

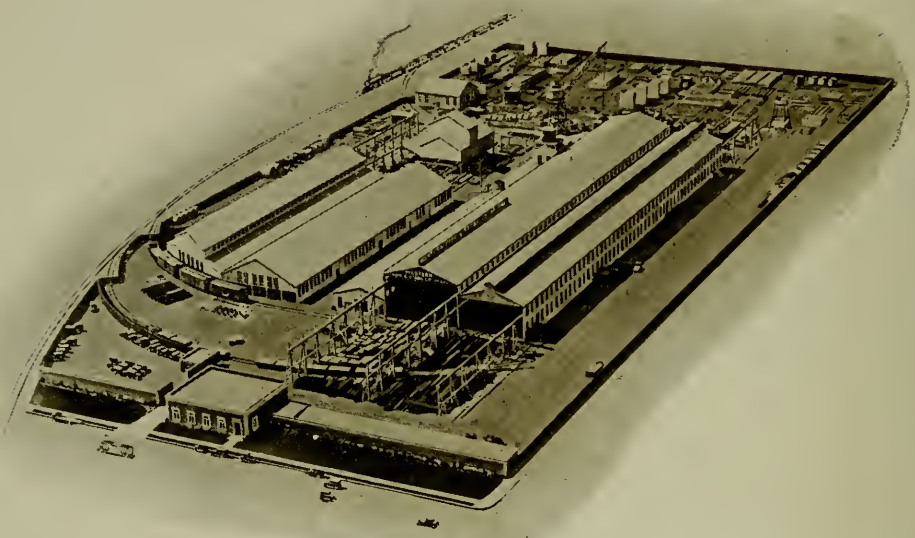
Designs - Fabricates - Erects - Installs
Equipment for

Water Works
Irrigation Projects
Gas Plants
Hydro-Electric Power Plants
Oil Refineries
Canneries
Sugar Refineries
Paper Mills
Chemical Plants
Packing Houses
Ice Plants
Soap Factories
Flour Mills
Saw Mills
Mines

WESTERN PIPE AND STEEL NEWS



WESTERN PIPE AND STEEL COMPANY
OF CALIFORNIA



LOS ANGELES PLANT

Santa Fe and Slauson Avenues

Area 16½ acres—Frontage 630'—Depth 1215'

Other Plants at

SOUTH SAN FRANCISCO · FRESNO · TAFT AND PHOENIX

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME 1 AUGUST, 1924 NUMBER 4

Western Pipe and Steel Keeps Pace with Los Angeles Growth

In 1781 *a band of* 140 *colonists journeyed from Mexico to found a settlement in Alta California. Their instructions were to grow food for the soldiers who were holding this principality for Spain. They called their little settlement Nuestra Senora la Reina de los Angeles—Our Lady Queen of Angels. Growth was slow. In* 1847 *the population was* 1500. *In* 1860 *it was* 4400. *By* 1870 *it had only reached* 5600. *But today the city of Los Angeles has a population of* 1,225,000 *souls.*

PERHAPS the most important single factor in the phenomenal growth of Southern California and its great metropolis, Los Angeles, has been water. Community spirit, cooperation, climate, vision and indomitable courage have all helped create the Southland that is, but the transformation of a desert waste into the most famous of all earth's garden spots could never have been effected without the magic of water. The history of this region of never-ceasing wonders is primarily the history of the bringing of water to the land and its people.

Western Pipe & Steel, and the predecessor companies merged into it, became a factor in this water development more than thirty-seven years ago. From the late Eighties to the present time this company has been active in the manufacture and installation of facilities for the transmission and storage of water.

When Western Pipe & Steel's first riveted steel water pipe was laid in this region, Los Angeles had a population of less than 50,000. At that time the great American hegira to Southern California had not begun. No one dreamed that in a little more than a third of a century this would be a city of more than a million people, a center of agriculture, industry and manufacture, the capital of the oil world, the financial hub of the Southwest, one of the leading seaports of the United States, and the Mecca of homeseekers and tourists from all over the world.

Similarly, the founders of Western Pipe & Steel could not foresee that this company would reach its present high place among Pacific Coast manufacturers. In the years that followed its foundation this company has fabricated thousands of miles of pipe. It has built flumes and penstocks for great power companies. It has played a helpful part in the construction of the great Owens River Aqueduct that brings water to Los Angeles from the mountains 250 miles away. It has furnished galvanized corrugated culverts to drain thousands of miles of highways and railways. And for the greatest of California's industries it has pioneered new paths in tankage and refinery equipment—building, for instance, within a period of sixteen months (1922-24), seven and one-half million barrels of oil storage tanks, in large sizes alone (i. e. 55,000 barrels and larger), and this without embarrassment or interruption of its other activities.

Situated on Santa Fe Avenue between Slauson Avenue and 55th Street, the Los Angeles plant of Western Pipe & Steel covers an area of sixteen and one-half acres.

The frontage is 630 feet—an entire block—while the depth is 1215 feet. Tracks of both the Southern Pacific and Santa Fe Railroads pass through the plant, and are so arranged that raw materials are discharged from cars at one end of the plant while finished products are loaded at the other.

In ground plan—the coordination of offices, shops and yards — this plant is recognized as a model. The various units, complete in themselves, form a symmetrical whole that expresses efficiency and order.

The office building is an attractive structure of red brick flanked by high walls extending the length of the block. Trim lawns set off with evergreen shrubs and trees, sound that note of beauty which modern business recognizes as being altogether in harmony with and helpful toward the highest utility. Better work is done in better surroundings. In a city like Los Angeles, where civic consciousness is very strong, to beautify one's manufacturing plant is to command the respect of all good citizens.

Within the walls are garages with ample space for the cars of all, both office and shop workers. In Los Angeles nearly everybody rides to work in his own machine. Western Pipe & Steel relieves a natural anxiety by housing all the cars of its workers free of charge.

The plant itself is the last word in manufacturing equipment. Punches, presses, shears, rolls and riveting machines exhibit the latest refinements and improvements. All hoists are operated by electricity or air; there is not a chain hoist in the plant. The construction of the buildings is all-steel. The company maintains its own employment office, also an emergency hospital, within the grounds.

The products embrace everything that is made of steel sheets or plates, from No. 26 gauge sheets to one-inch plates, and, in addition, shapes for structural steel buildings are fabricated here.

(*Continued on page* 8)

Partial view of Los Angeles plant of W. P. & S. Heavy plate shop, craneway, and plate storage yard at right. Water pipe and casing shop at left.

An Old Riveted Steel Pipe Line

By F. C. Finkle, *Consulting Engineer*
Los Angeles

THIRTY-SEVEN years ago — in 1887—the first riveted steel pipe line designed and supervised by the writer was manufactured and laid under contract by the plant that afterwards grew into the Western Pipe & Steel Company of California. The line extends from Lytle Creek, northwest of San Bernardino, to Highgrove, a total of 44,811 lineal feet of 24″ diameter pipe.

This pipe line was originally designed and built for the Vivienda Water Co., but was later sold to the Riverside-Highland Water Co. which still owns and operates it. At the crossing of the Santa Ana River between Colton and Riverside, the pipe line was originally suspended on a railroad bridge. This became unsafe and had to be removed, so the pipe line was placed on concrete piers.

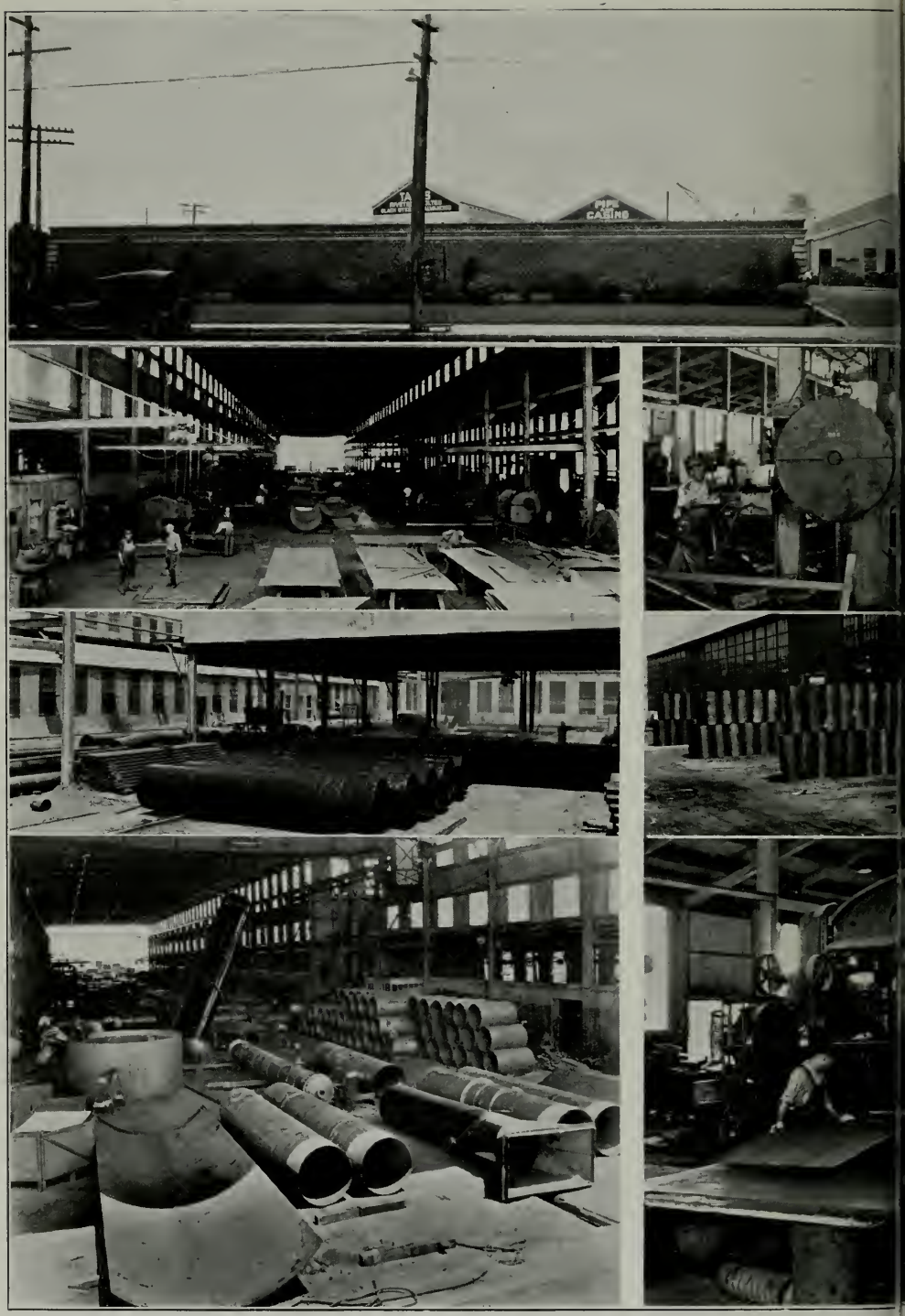
Between Colton and Riverside the line follows the Pacific Electric Railway, but the pipe has never been affected by electroylsis. Examination a few months ago showed that this 37-year-old line is in very good condition. It promises to be useful for another 37 years.

Most of the pipe is buried in the ground, the only part above ground being about one-half mile across the Santa Ana River, but it is all in good condition, showing that neither the soil nor electric current has seriously affected it. When laid it was double-dipped in asphaltum.

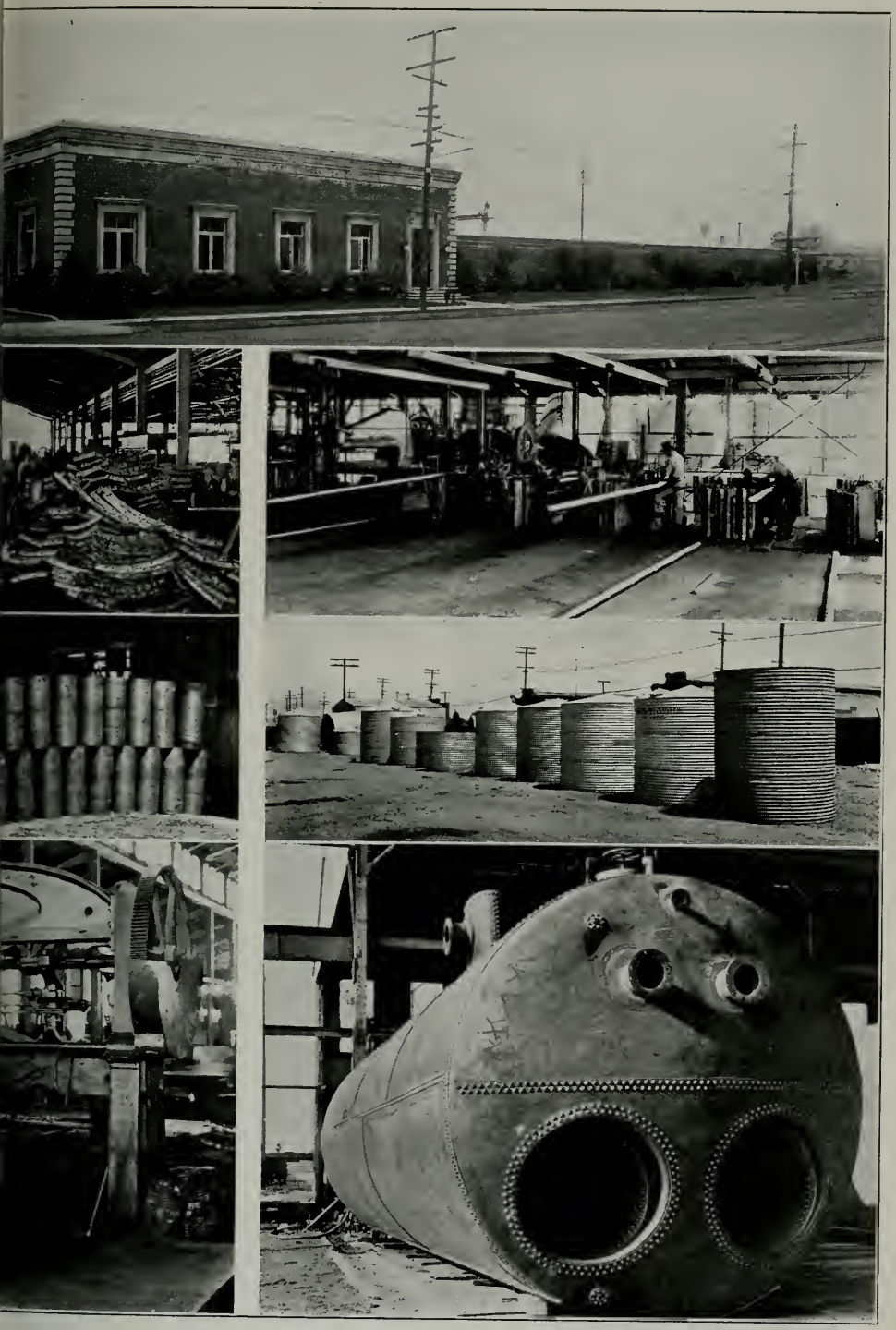
Practically all of the pipe rests where it was originally laid, except where some street changes in Colton and vicinity have required that it be removed. During such changes in recent years I have been able to inspect it, and found the metal sound and the asphalt coating nearly perfect. This is the oldest large riveted pipe line in Southern California,

(*Continued on page* 8)

Thirty-seven-year-old 24″ riveted steel pipe line crossing Santa Ana river between Colton and Riverside, Calif., which recent inspection showed in good condition.



EXTERIOR AND INTERIOR VIEWS OF WESTERN PIPE & STEEL CO.'S 16-
and walls. Upper row (left to right)—A long shot through the heavy plate shop, whic
Water pipe shop, showing round-seam riveting of 4" pipe. Center row (left to right)—
of various sizes, ready for the field.—Galvanized corrugated tanks in a variety of sizes,
shop. Picture shows large riveted steel water pipe, steel smoke stacks, tanks, stills, retort
of special work. Internal-fired still made for Western Refining Co., San Pedro. The still



ANGELES PLANT—*Top—Panorama of 630-foot front, showing office building, lawns 0'.—Making steel tunnel lagging in the sheet steel specialty shop for the City of Seattle.—ip shed. Five sizes of riveted pipe, from 4" to 36", are shown in the picture.—Well casing pment. Lower row (left to right)—A wide range of work is handled in the heavy plate of the big multiple punches, punching plates for W. P. & S. bolted tanks.—An example an it looks: diameter 13' 5", length 42', ½" plate.*

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5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

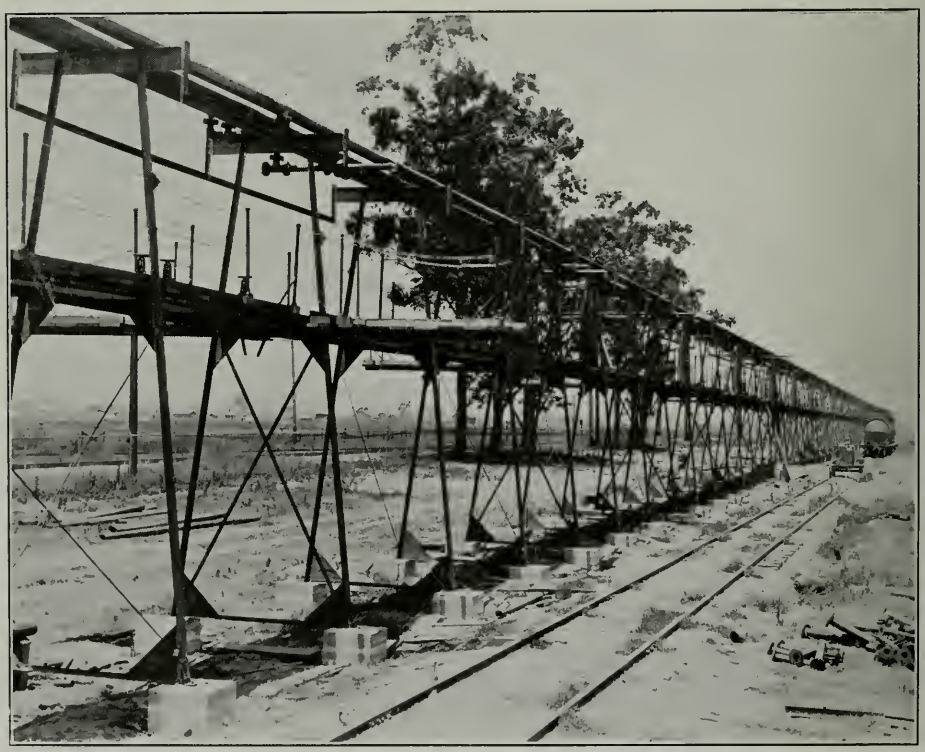
THIS issue of *Western Pipe & Steel News* is designed to sketch the resources of our Los Angeles plant, and to indicate the variety of its products. Future issues will deal with the big San Francisco plant, and the plants at Fresno, Taft, and Phoenix, Arizona.

By way of illustrating one of the major contracts recently executed at Los Angeles, we reproduce on the cover an airplane view of the refinery and tank farm of the Richfield Oil Company at Hynes, near Los Angeles.

This contract was exclusively Western Pipe & Steel; that is to say, not only the steel storage tanks, absorption towers, agitators, retorts and stills were designed and manufactured by this company, but also every other equipment item in the picture, including loading rack, structural material, tail house, water tower, stacks and fittings.

The steel storage thus far designed, fabricated and erected for the Richfield Oil Company includes 31 tanks, ranging in size from 1250 barrels to 80,000 barrels capacity, all with water seal roofs. There are two of the 80,000-barrel tanks and two 90,000-gallon Foamite tanks. The hemispherical-bottom water tank erected on an 87-foot tower has a capacity of 25,000 gallons. The steel loading rack is 1330 feet long. Structural steel for all buildings shown in the picture was fabricated and erected by Western Pipe & Steel.

Richfield refinery, therefore, stands as a striking example of the range and resourcefulness of Western Pipe & Steel.



Richfield Oil Co.'s loading rack for tank cars, built by W. P. & S. at Hynes, Cal. All equipment for the Richfield refinery was built and installed by W. P. & S.

Economical Phases of Steel Pipe

By M. S. Robertson, *Manager*
South Los Angeles Land & Water Co.

IN the water business, as in all lines of human endeavor, we are guided by the signposts of experience, and the experience of the South Los Angeles Land & Water Company has proved that double-dipped, riveted steel water pipe possesses, in addition to other essential qualities, that of the highest economy.

We began using steel pipe over twenty years ago, and the earliest pipe laid is still in excellent condition, giving no trouble. From small beginnings we have increased our footage year by year, keeping pace with the growth of our communities, until today we have more than one hundred miles of steel pipe in the ground, the sizes of our mains including 4", 6", 10" and 14" pipe, serving 5500 customers.

The economy of steel pipe begins, of course, with first cost and continues with installation. Again, steel pipe is easy to tap for service connections, and there is no question of its long life. Furthermore —and this is very important—this economy is quickly made evident when it becomes necessary to replace smaller mains with larger, as frequently happens with us, owing to the rapid growth of the district.

Western Pipe & Steel has manufactured over 20,000 feet of 4" steel pipe for us in the last 90 days, most of it now in the ground in residence districts. We serve also an important industrial district, our territory extending from Slauson Avenue south to Manchester Avenue, east from Santa Fe Avenue to Compton Avenue, taking in part of the City of Vernon and including Goodyear Park and Laguna. Our water system is 100 per cent steel pipe.

Laying W. P. & S. double-dipped 4" steel riveted water mains in residence district for South Los Angeles Land & Water Co., which has over 100 miles of steel pipe in the ground.

Western Pipe and Steel Keeps Pace

(*Continued from page 2*)

The principal units of the plant are: (1) Heavy plate shop, 70′x500′ under cover. Two five-ton traveling cranes with craneway extending 150′ in the open at both ends. (2) Forge and weld shop, 60′x500′. (3) Structural steel department, 50′x300′. (4) Water pipe and casing shop, 80′x380′. (5) Bolted and galvanized tank department, and sheet steel specialties, 110′x300′. (6) Warehouse, 50′x500′. (7) General offices.

Other units are machine shop, dip shed (with 40′ kettle), acetylene plant, carpenter shop, testing sump, field equipment building, field equipment storage yard, hospital, employment office, and a 15-ton industrial crane on track.

The fact that two transcontinental railroads operate within the plant enclosure means no lost motion between factory and transportation.

The average number of employees is 400. The labor turnover is far below the average. This makes for efficiency, and also reflects wisdom in management and operation. Furthermore, it shows high morale.

An Old Riveted Steel Pipe Line

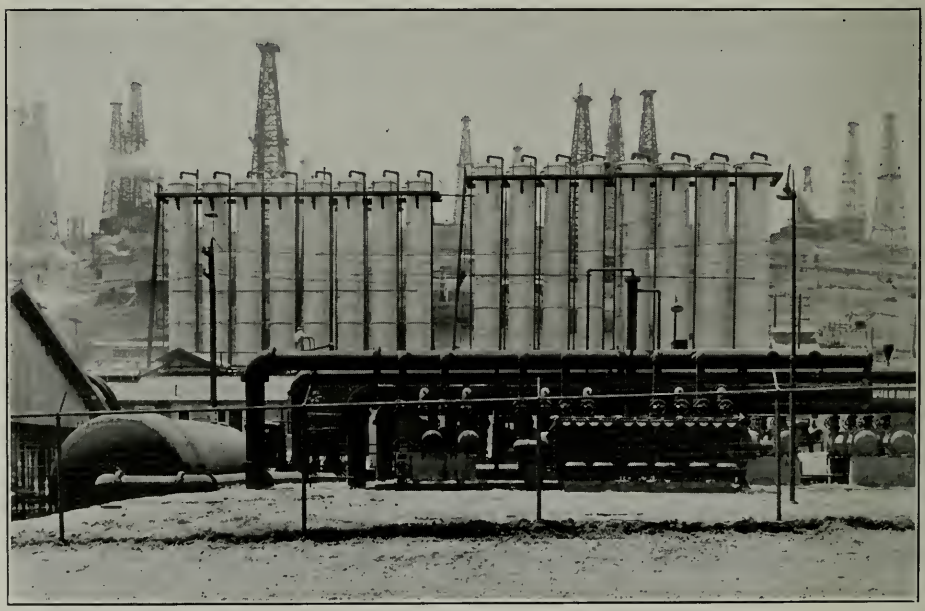
(*Continued from page 3*)

and its good condition is the best evidence of the long life of such pipe.

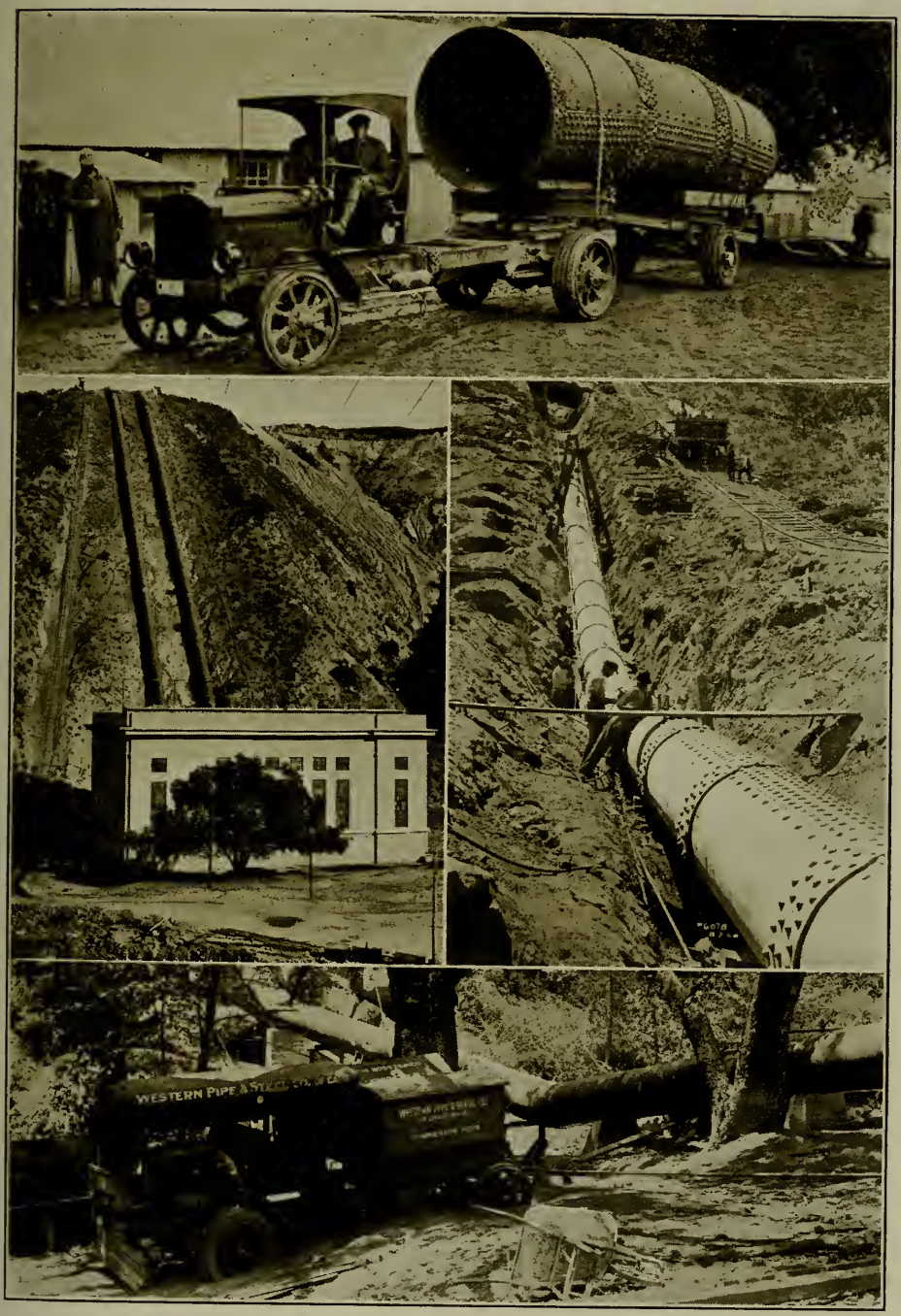
Another case demonstrating the resistance of riveted steel pipe to soil corrosion and electrolysis came under my observation when I appraised the distributing system of the Crafton Lugonia and Redlands Domestic Water Co. in 1912 before it was transferred to the City of Redlands. The pipes in this system varied in age from a few years to 25 years, and they showed but slight corrosion and no effect from electrolysis.

These installations do not, of course, cover all work executed by Western Pipe & Steel which has come under my supervision as chief or consulting engineer. Many other contracts have been carried out for my clients by them, including the City of San Bernardino, Covina Irrigation Co., and others.

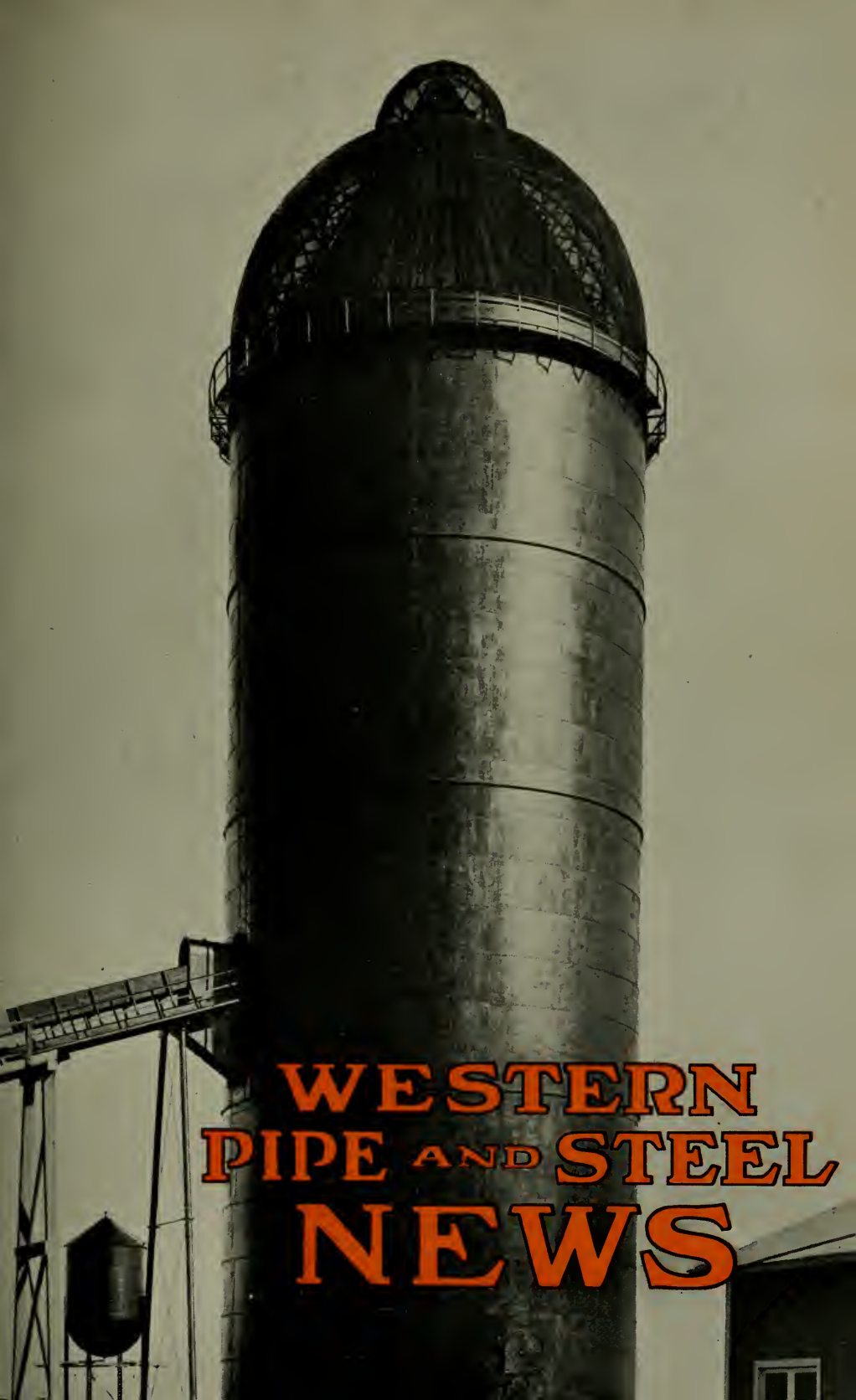
The sum of my experience impels me to say of Western Pipe & Steel, that all the pipe it has manufactured and laid is above criticism. No failure, no serious mistake has occurred on their work, so far as I know, in 37 years.



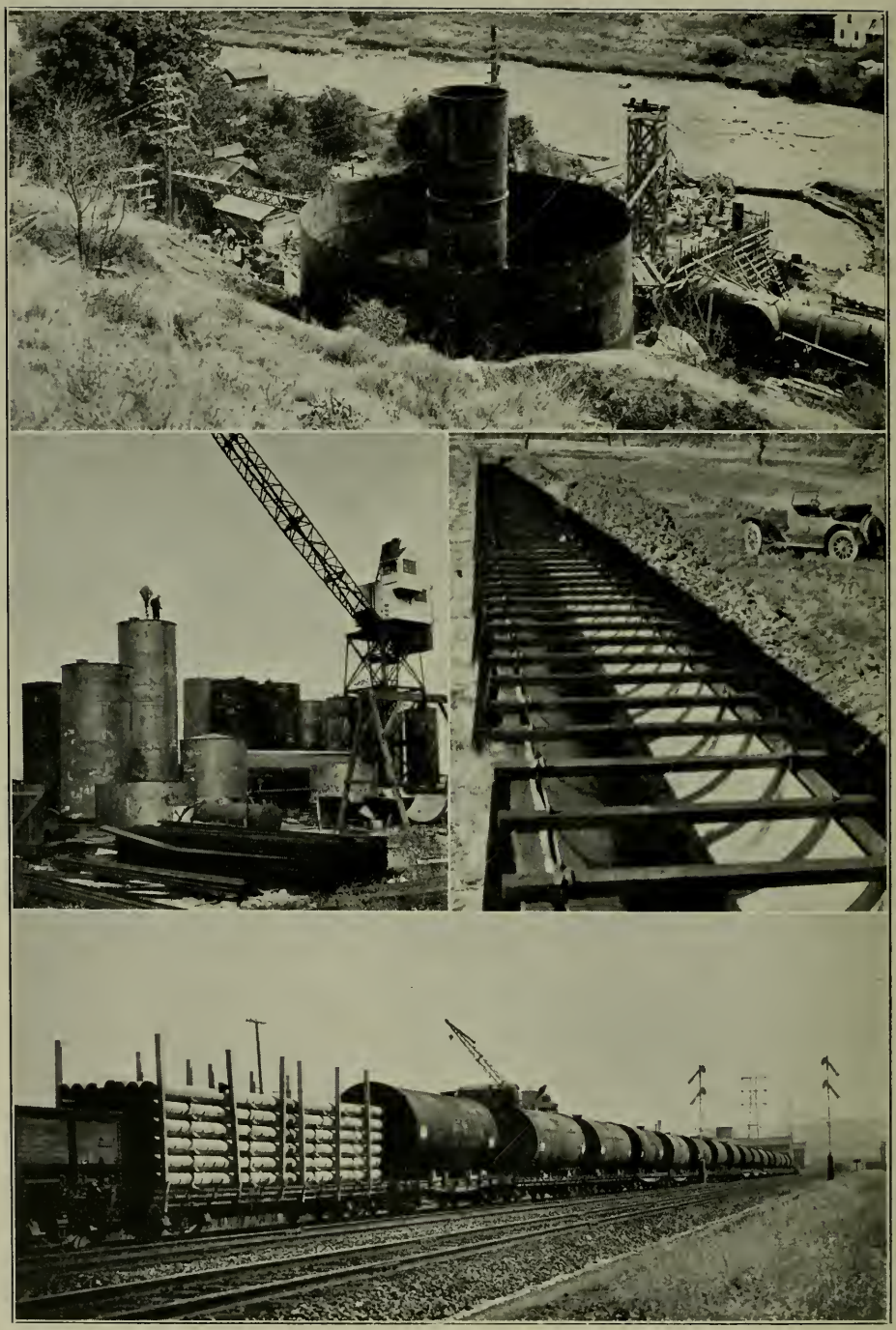
World-famous Signal Hill at Long Beach. Picture shows absorption towers built by W. P. & S. for Shell Co. of California.



SOME EXAMPLES OF HEAVY PLATE WORK FABRICATED AT LOS ANGELES—*Upper—Penstock section for City of Los Angeles, en route to Power Plant No. 2, San Francisquita Canyon. Left—View of power house, showing penstock installed, City of Los Angeles Power Plant No. 2, San Francisquita Canyon. Right—W. P. & S. installation of penstock for Southern California Edison Co. Big Creek No. 3 Power Plant. Lower—"Hell Hole" syphon, fabricated and installed for San Diego County Water Co.*



WESTERN PIPE AND STEEL NEWS



SAYING IT WITH PICTURES—Top—Differential Surge Tank, California-Oregon Power Co., Klamath Falls. Left—Station (oil) tanks, in finishing yard. Right—Galvanized Steel Flume on trestle. Bottom—Trainload of W. P. & S. products leaving South San Francisco plant, including 16 cars of oil station tanks. The car in front of the tanks is loaded with wrapped steel water pipe.

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SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME 1 SEPTEMBER, 1924 NUMBER 5

Presenting a Wide Range of W. P. & S. Specialties

FOR the first time since *Western Pipe & Steel News* was established, a wide range of subjects is embraced within a single issue. Each previous number featured a particular line. This is a Specialty number. It pictures and describes some of the more striking specialties fabricated and installed by Western Pipe & Steel. The emphasis is on variety.

There are so many specialties on the W. P. & S. list that the treatment has to be selective. Rather than attempt to exhaust the subject, the endeavor is to present what is most important, most expressive of the capabilities of an up-to-date organization wherein the work of five plants is carried on under unified control.

No layman—and not every engineer—realizes how many different kinds of work can be done on a given machine by slightly modifying its parts. Shop technicians show endless ingenuity in adapting the old machine to the new task. It is obvious that this makes for economy of fabrication. In the hands of a master workman who has imagination as well as skill, a huge mass of machinery becomes an almost plastic instrument for cutting cost. And also for speeding production.

For instance, the big machine in the Los Angeles plant of W. P. & S. that is ordinarily used for cutting, punching or stamping heavy plates, has been temporarily modified to turn out comparatively light tunnel lagging.

What applies to fabrication can be said also of those ingenious shortcuts that make the installation of the finished product a process of almost magical speed. Consider, for instance, the use of the caterpillar crane in unloading water pipe in the field from a work-train of flat cars, thus saving time and money.

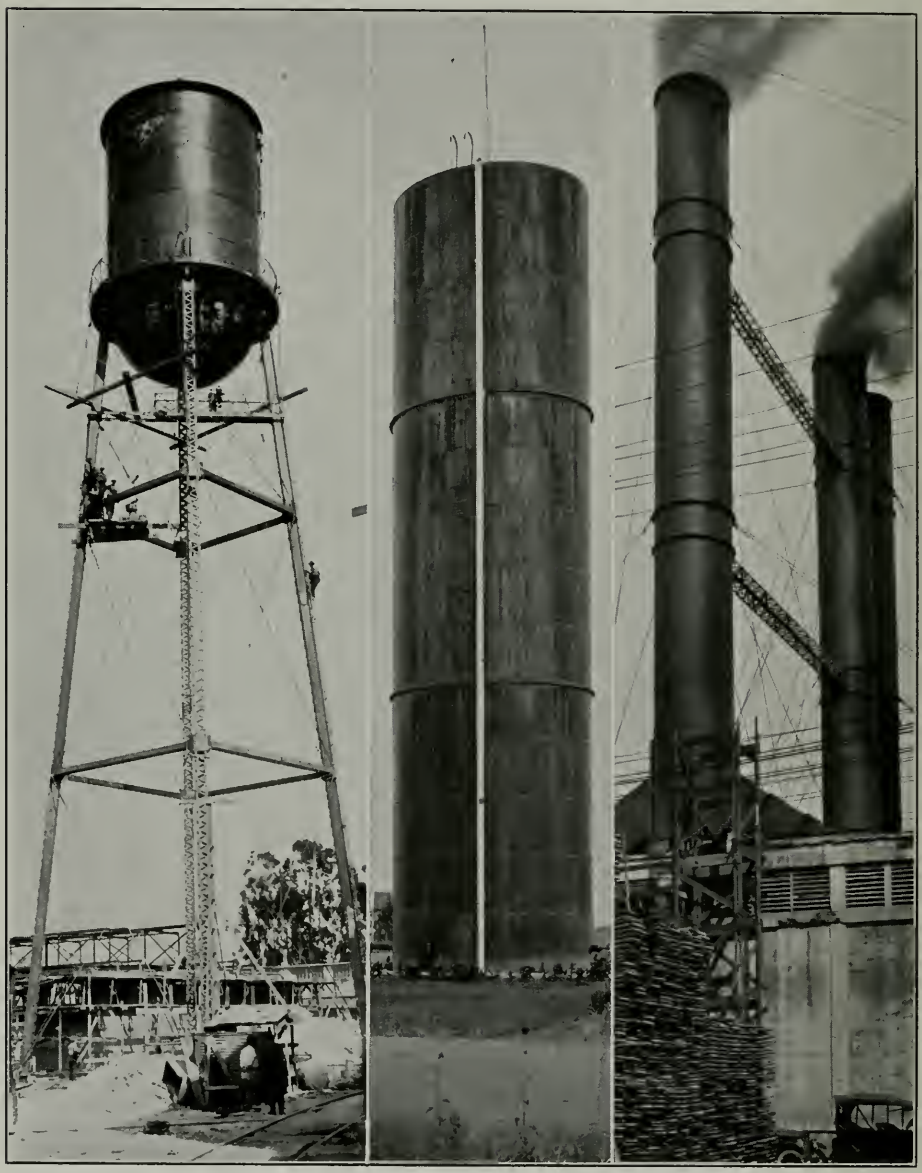
In this matter of adaptability, in lifting fabrication and installation methods out of the heavy ruts of usual practice, Western Pipe & Steel has done a great deal of pioneering. This has made possible the building up of a remarkable business in specialties.

While the plants of this company are turning out steel water pipe, tanks, corrugated culvert, well casing and surface irrigation pipe, they are also filling orders for such specialties as water towers, stand pipes, refuse burners, smoke stacks, gas holders, penstocks, galvanized open flumes (all of which are pictured in this number), and many others not shown in this issue, including air receivers, air condensers, pressure and gravity tanks, galvanized air pipe and dredge pipe.

In order to show in this issue as wide a range of specialties as possible, text has been subordinated to pictures. It is respectfully submitted that not many plants in the West could present such a picture-story of specialties as is here given by W. P. & S.

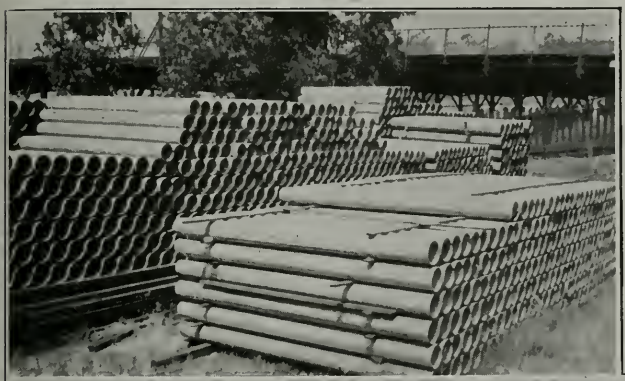
It is hardly necessary to say that W. P. & S. policy calls for the same painstaking care in the execution of a specialty order as is given to a contract for twenty miles of Hetch Hetchy sixty-inch pipe or for a battery of 178,000-barrel oil storage tanks for the Associated Oil Company.

Varied Types of W. P. & S. Work

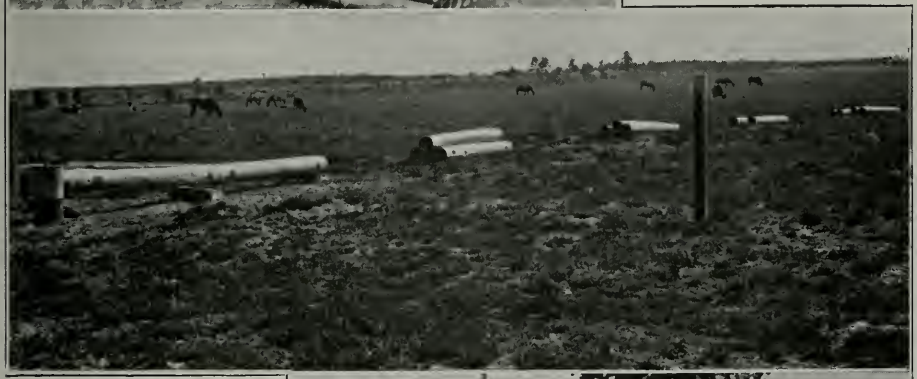


Pictures tell the story of the endless variety of W. P. & S. products. Left—Hemispherical-bottom riveted steel water tank of 75,000 gallons (312 tons) capacity, on 100′ steel tower. Both tank and tower designed, fabricated and installed by W. P. & S. for West Coast Porcelain Manufacturers, Millbrae, Calif. Center—Steel standpipe 15′ x 70′ designed, fabricated and erected for San Joaquin Valley Farm Lands, San Joaquin, Calif. Right—Steel smokestacks, 8′ x 100′, designed, fabricated and erected for Great Western Power Co. at San Francisco.

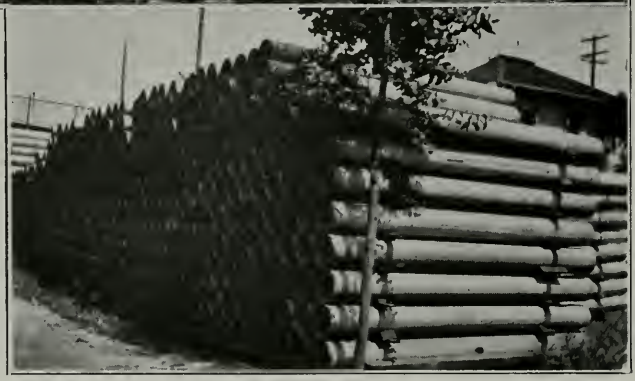
Portable Surface Irrigation Pipe



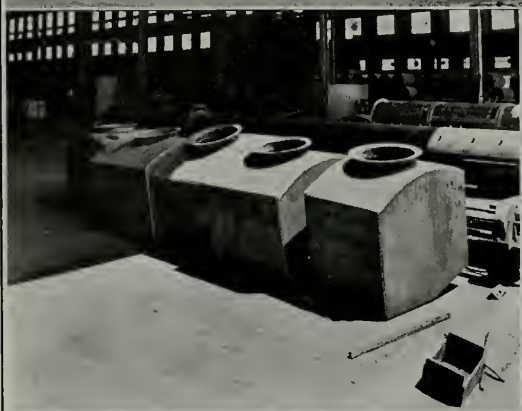
W. P. & S. galvanized surface irrigation pipe is extensively used for surface distribution of water in connection with underground irrigation systems.

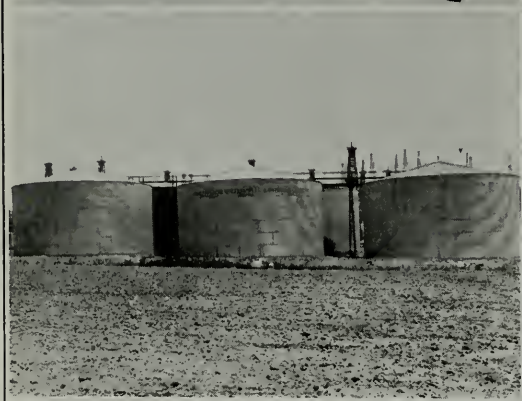


Elimination of the losses through seepage and evaporation that invariably accompany ditch distribution, is possible through the use of this pipe.

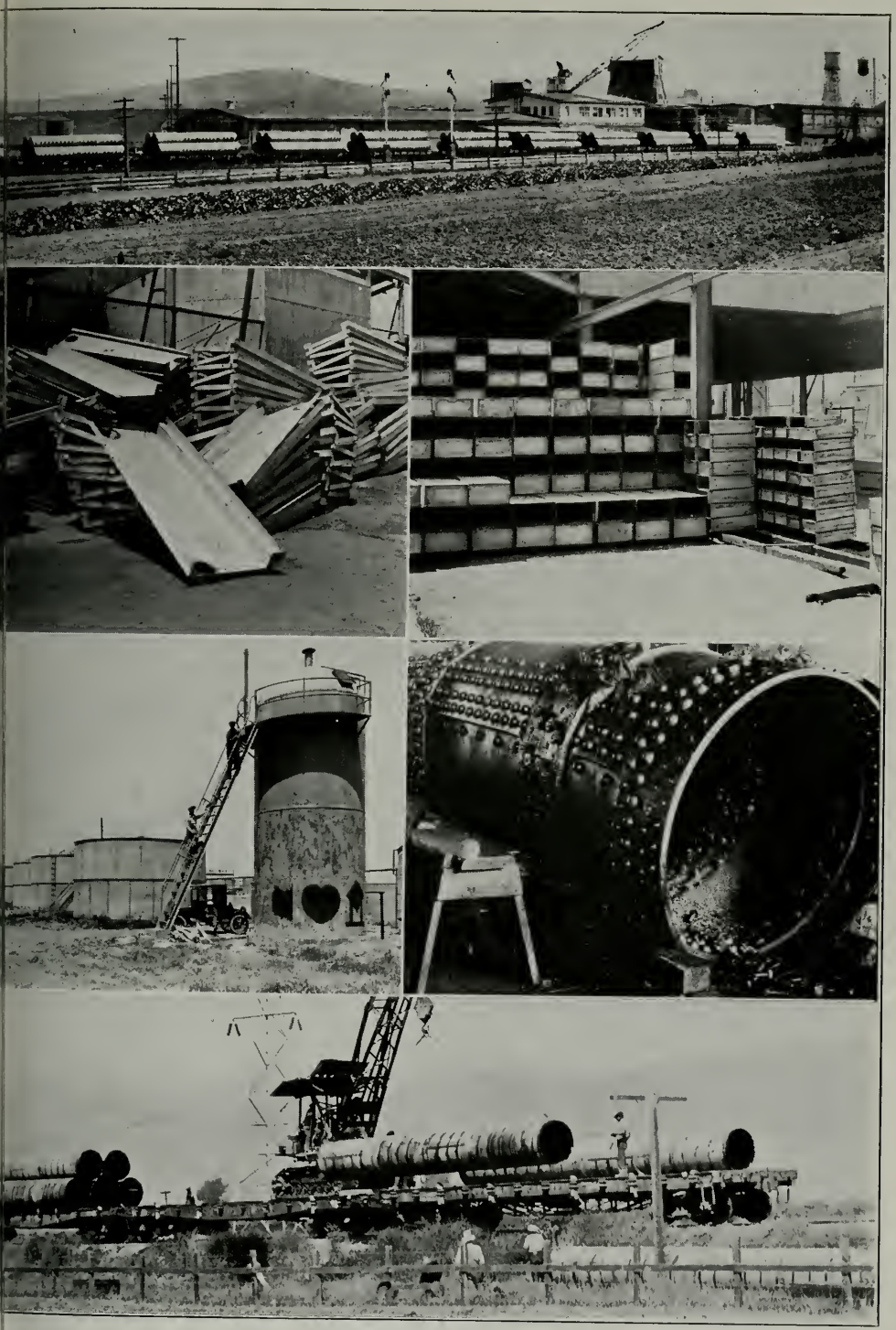


THE COVER PICTURE—*The cover plate of this number of Western Pipe & Steel News is from a photograph of a refuse-burner built by W. P. & S. for the Sugar Pine Lumber Co. at Pinedale Jct., near Fresno. The refuse-burner is 45′ diameter and 110′ high. This and one other are the largest refuse-burners in the world. The hemispherical-bottom water tank on steel tower is also a W. P. & S. product.*





A WIDE VARIETY OF WESTERN PIPE & STEEL PRODUCTS—*Top—Train lo*
Upper row (left to right)—Sectional wagon tanks turned out for a big oil company at I
Hynes, Calif.—These galvanized pans are good examples of special flange and break wo
plant.—Second row (left to right)—Battery of six 3000-barrel galvanized corrugated tan
near Fresno.—Agitator and battery of six 1500-barrel bolted steel tanks for Delaney Ref
—Bottom—W. P. & S. field crew unloading Western Pacific work train near Irvingto



rapped water pipe for Spring Valley Water Co. leaving South San Francisco plant. —Foamite tanks, steel smoke-stacks, and water tank and tower for Richfield Oil Co., . P. & S. is equipped to do.—Ice cans in three sizes, ready for shipment from Los Angeles en State Refining Co., Long Beach, Calif.—W. P. & S. well-casing and rig in the field Hill.—Example of heavy penstock work for Pacific Gas & Electric Co.'s Drum penstock. his pipe will connect Spring Valley's Calaveras reservoir with the Hetch Hetchy line.

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444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

IN this number we generalize about our facilities for what may be termed "special" products.

It seems timely to show the variety that justifies our statement that we can produce anything made of steel sheets or plates.

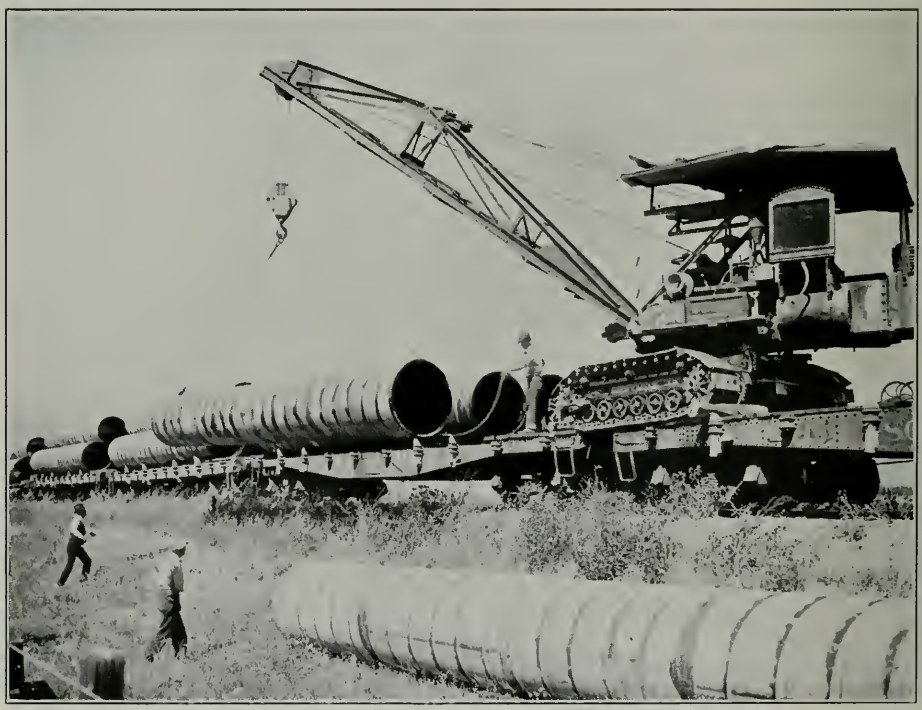
Demand for full information regarding our special products comes insistently from many sources. Engineers, contractors, purchasing agents, county supervisors, municipal officials, ranchers, manufacturers, and others who have long been familiar with certain W. P. & S. products have, we learn from time to time, thought of us mainly in terms of the particular product which they originally began buying from W. P. & S. What they know about our superior quality of design, materials and workmanship is limited to their contact with one or two of our lines.

This number has been planned especially to meet the demand for fuller information regarding our manufacturing range, and we are confident it will give a broader picture of Western Pipe & Steel than our customers have had.

We call attention particularly to the fact that our activities embrace not only the *manufacture* of every article pictured or described herein, but also *designing,* and *erection* or *installation.*

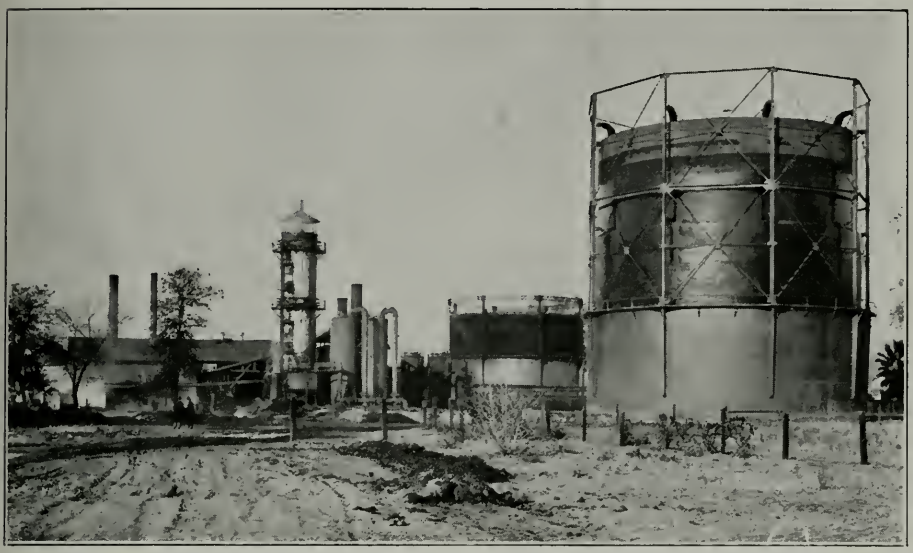
* * * *

The mailing list of *Western Pipe & Steel News* grows steadily. If you are not yet on the mailing list, notify us and we shall see that you receive the *News* regularly.



W. P. & S. field service plays an important part in many contracts. Picture shows field crew unloading pipe with caterpillar crane, which travels from car to car.

Gas Holders—Large and Small



W. P. & S. not only designs, fabricates and erects gas holders of any capacity, but is also equipped to tear down old gas holders for re-erection or removal. Upper picture shows 200,000 *cu. ft. capacity gas holder, also generator, scrubbers and washbox designed, fabricated and erected for Central Counties Gas Co., Visalia. Lower—Baby gas holder* (12,000 *cu. ft. capacity*) *for oxygen. Plant of Western Oxygen Co., Los Angeles.*

W. P. Fuller & Co. Like W. P. & S. Tanks

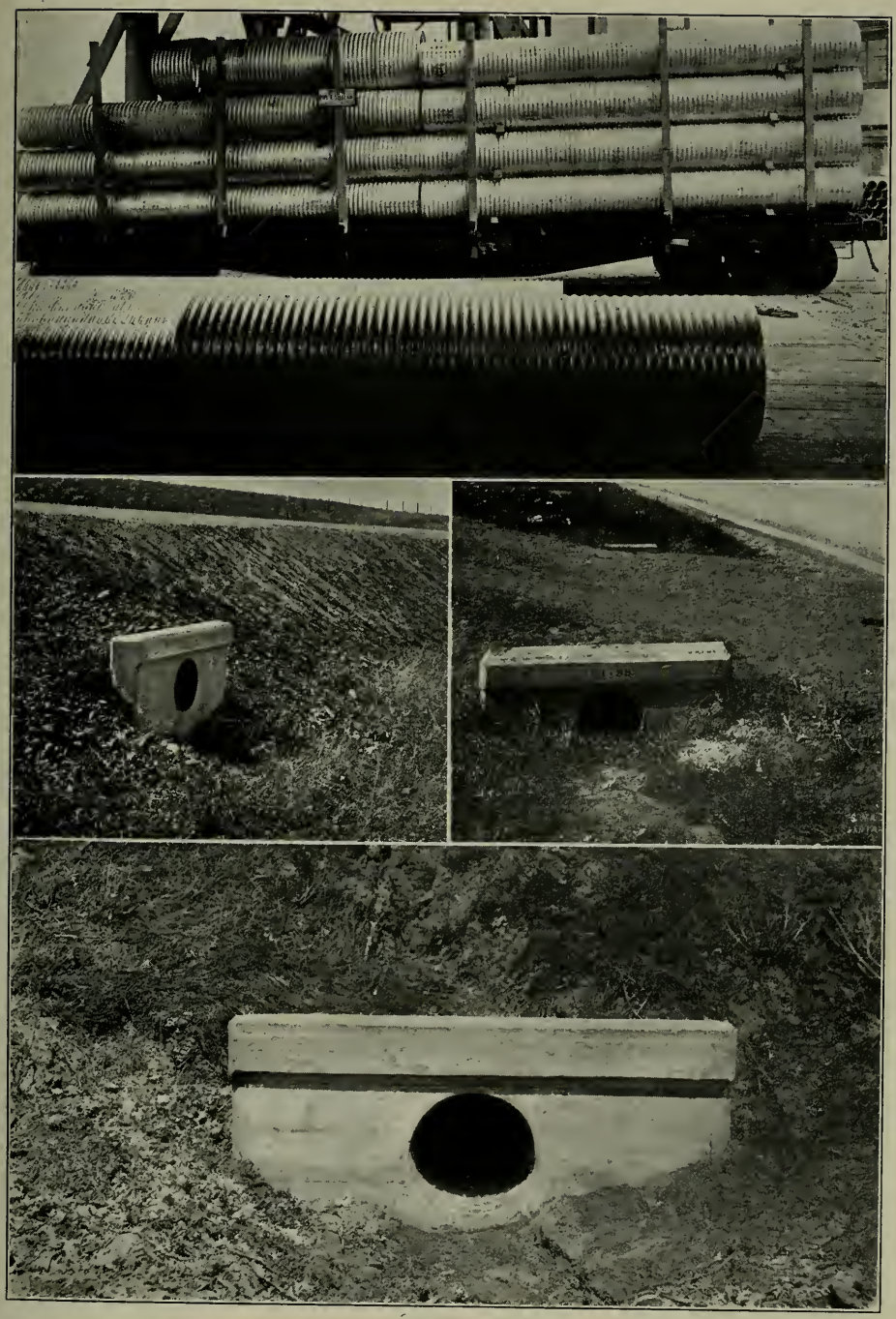
ONE of the most completely equipped plants of its kind in the West is that of W. P. Fuller & Co. at Los Angeles. At this plant a battery of ten 20,000-gallon and fifteen 8500-gallon riveted steel tanks for the storage of linseed oil and turpentine was recently installed by W. P. & S. Planned to give the utmost economy in cost of handling and labor, this installation is the last word in scientific design.

Western Pipe & Steel not only fabricated and installed the tanks, but also all accompanying equipment, including inlet and outlet pipes, inside ladders, outside platforms, hand rails, gauge boards, by-passing connections, Foamite connections, etc. The picture on this page shows only a part of the installation, there being another battery at the other end of the block. All the tanks are cone top type.

So satisfactory was this equipment that W. P. Fuller & Co. ordered similar equipment for their San Diego plant. This work is now under way. W. P. & S. was given a contract for the entire job, including structural steel and equipment complete.

This Company takes a pardonable pride in the execution of such work for a house of the reputation and standing of W. P. Fuller & Co. For more than seventy-five years this house has been one of the great paint and varnish manufacturers of this country. The name Fuller is synonymous with quality. It is reasonable to say that a firm which has built up through three-quarters of a century a reputation for manufacturing and selling the best, must also be credited with buying only the best.

Battery of W. P. & S. tanks at Los Angeles plant of W. P. Fuller & Co. W. P. & S. furnished ladders, platforms, hand-rails, gauge-boards, and all other equipment.



W. P. & S. GALVANIZED CORRUGATED CULVERTS—*Top—Carload of culvert for Southern Pacific Co., Natron cutoff. Left, Right, and Bottom—Views of W. P. & S. installations of culvert on famous Skyline Boulevard south of San Francisco. W. P. & S. culverts are noted for long life and superior rust-resisting qualities. They are fabricated from heavily galvanized, copper-bearing steel.*

In the West its "Western"

With this symbol of craftsmanship Western Engineers, Purchasing Agents, Contractors and Other "Buyers of the Best" have come to associate *Quality* in Fabricated Steel Products

Western Pipe & Steel Co.

of CALIFORNIA

444 MARKET ST.
SAN FRANCISCO

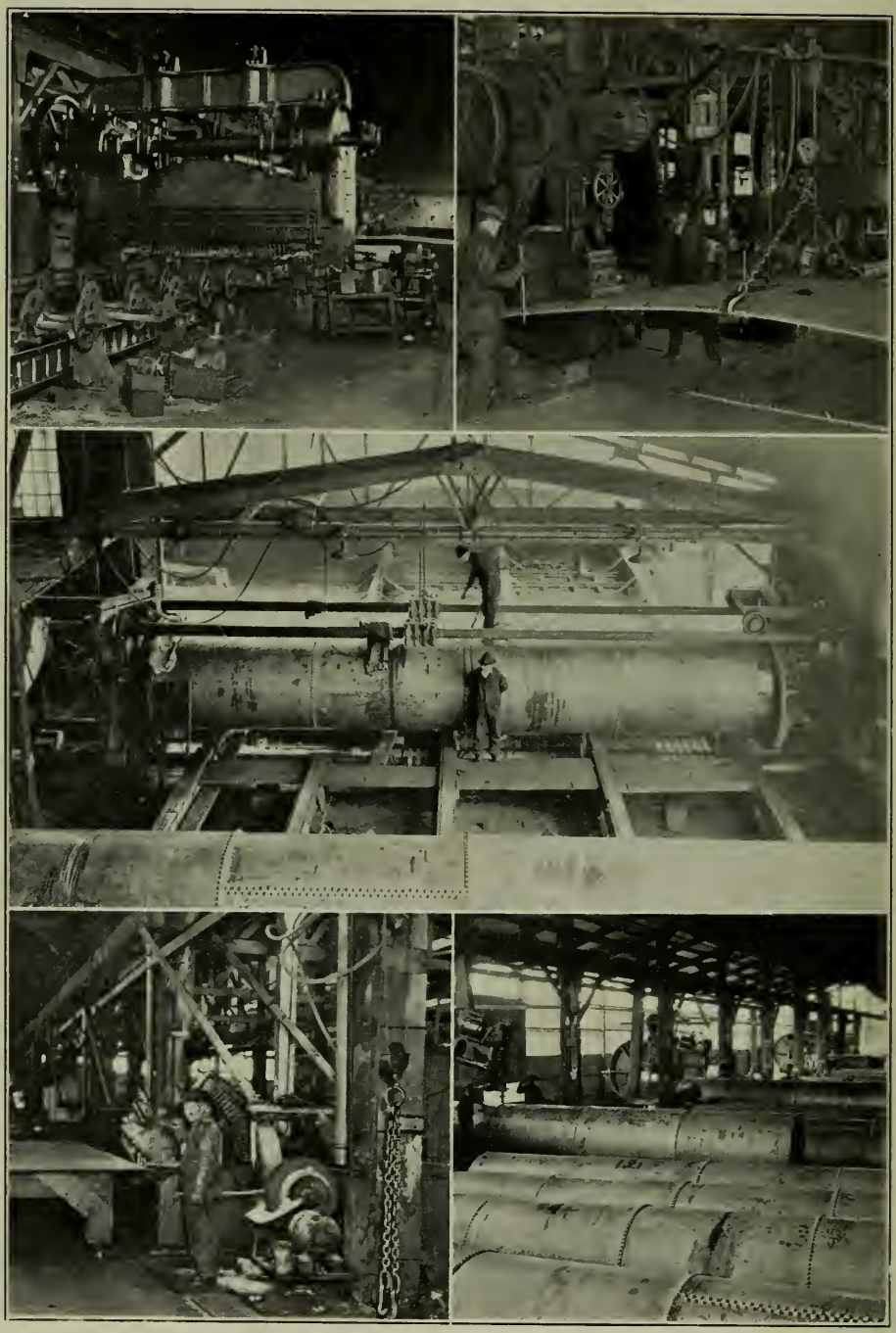
5717 SANTA FE AVE.
LOS ANGELES

FACTORIES

SOUTH SAN FRANCISCO · LOS ANGELES · FRESNO · TAFT · PHOENIX

Designers · Fabricators · Erectors of General Plate Work

WESTERN PIPE AND STEEL NEWS



FABRICATING 60" RIVETED PIPE FOR HETCH HETCHY AT SOUTH SAN FRANCISCO—*Upper left—Multiple punch with automatic spacing table. Upper right—"Breaking" end of plate. Center—W. P. & S. special testing machine, capacity 800 pounds per square inch. Lower left—Bevel shear. Lower right—Hydraulic riveting machines, sometimes called "Bulls." These machines rivet pipe up to 14' diameter.*

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME 1 OCTOBER, 1924 NUMBER 6

Western Pipe & Steel—A Big Enterprise on San Francisco Bay

"This town has twice been laid in ashes; but the young phoenix has risen on ampler wings than those that steadied the consumed form of its parent. It must be the great commercial emporium of California in spite of competition, wind and flames. Its direct communication with the sea, its magnificent bay and internal communications, have settled the question of its ultimate grandeur. Three years ago only a dozen shanties sprinkled its sand-hills; now, even with its heart burnt out, it looks like the skeleton of a huge city. That heart will be reconstructed, and send the life blood leaping through the system."

WALTER COLTON, 1850.

TODAY, less than seventy-five years after Colton penned his prophetic lines, who shall say that San Francisco has not travelled far on the road to that "ultimate grandeur" that must have seemed very remote, even to men of vision, in 1850? And yet, the present roaring metropolis of nearly 700,000 population—1,242,629 in the metropolitan area—sharply contrasted though it be with the town of 1850—is but the forerunner of a city that will eventually surpass New York.

In the decades since Colton wrote, San Francisco has marched with steady gait toward the destiny its founders read in the swinging of the tide and the blowing of the trade winds. The holocaust of 1906 served but to prove its indomitable spirit.

It has come to be the "city loved around the world"; a money capital whose financial transactions, gauged by bank clearings, show a healthy and prosperous growth from year to year; a city of homes and growing business whose real estate sales in a single year approached $160,000,000 and whose building permits last year neared the $50,000,000 mark; terminus of five transcontinental rail routes; port of a hundred steamship lines whose activities in 1923 showed nearly 7000 ships arriving and about the same number departing, with a total tonnage of 30,000,000; and last, but not least, a great industrial and manufacturing center whose factories and shops give year-around employment in earth's kindliest climate to tens of thousands.

The San Francisco history of Western Pipe & Steel goes back to the days of gold. In 1854 the Francis Smith Co. was established at Grass Valley, California, to manufacture riveted water pipe for the hydraulic miners of that famous camp. The company opened its San Francisco plant in the early sixties. The growth of the business was comparatively slow through the seventies and eighties. Eventually, however, the little shop was expanded into a fair-sized factory. Its activities were enlarged to include such products as culverts, well-casing, tanks and the like. Through a series of business transformations, that humble shop of the Francis Smith Co. became parent to the huge concern known today from Canada to Mexico as Western Pipe & Steel Company of California, with plants at South San Francisco, Los Angeles, Fresno, Taft and Phoenix. The original Shaw Batcher

Co. Pipe Works is also embodied in the present organization.

Strategically situated not only as to rail, highway and tidewater, but at the very door of what far-seeing men concede to be the future industrial center of the peninsula, the South San Francisco plant of Western Pipe & Steel ranks as one of the major industrial units of California.

The property has an area close to 100 acres, included in which is a ship channel 1700 yards long and 250 feet wide, with a water depth of 16 feet at low tide. This channel leads from the northern end of the plant into the deep water of San Francisco Bay, giving splendid facilities for water shipments. These shipments are coastwise and trans-Pacific, as well as to interior points on the two great California rivers, the Sacramento and the San Joaquin.

For rail shipments the plant's facilities consist of three spur tracks the full length of the plant from the main line of the Southern Pacific which parallels the property on the west. South San Francisco being within the yard limits of San Francisco, switching between Southern Pacific and connecting carriers is allowed. Thus shipments for points on the Western Pacific and Santa Fe railroads are handled much the same as if those roads had spur tracks into the plant direct. It is a common sight to see solid trainloads of W. P. & S. products leaving South San Francisco.

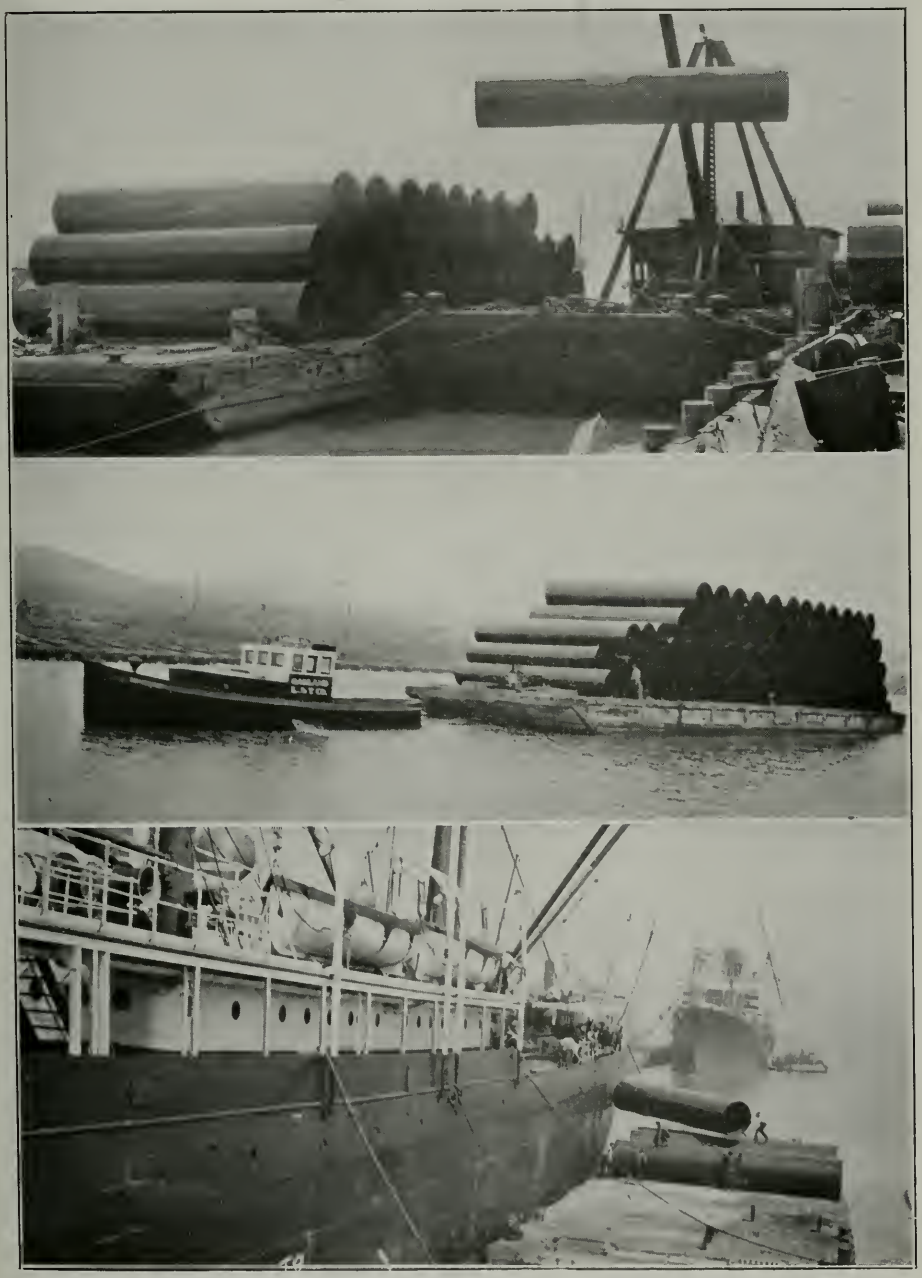
The plant is scientifically laid out. The orderly arrangement and progress of fabrication, from stock pile to finished product, have been admired by engineers and factory experts. The three spur tracks are so arranged that finished products can be loaded on cars at the spot where they are completed. For water shipments a miniature railway equipped with push cars serves all parts of the plant, so that even the largest pipe sections and tanks can be run alongside the barges afloat in the channel.

The main shop buildings have a total floor area under cover of about 190,000 square feet. The principal units of the plant are: (1) Heavy plate shop, 120'x 800'; (2) galvanized corrugated tank and culvert department, 80'x200'; (3) water pipe and sheet metal department (well-casing, etc.), 80'x320'; (4) machine shop; (5) store room; (6) storage

(*Continued on Page Seven*)

Manifold fabricated by W. P. & S. for High Line Canal Co., Arizona

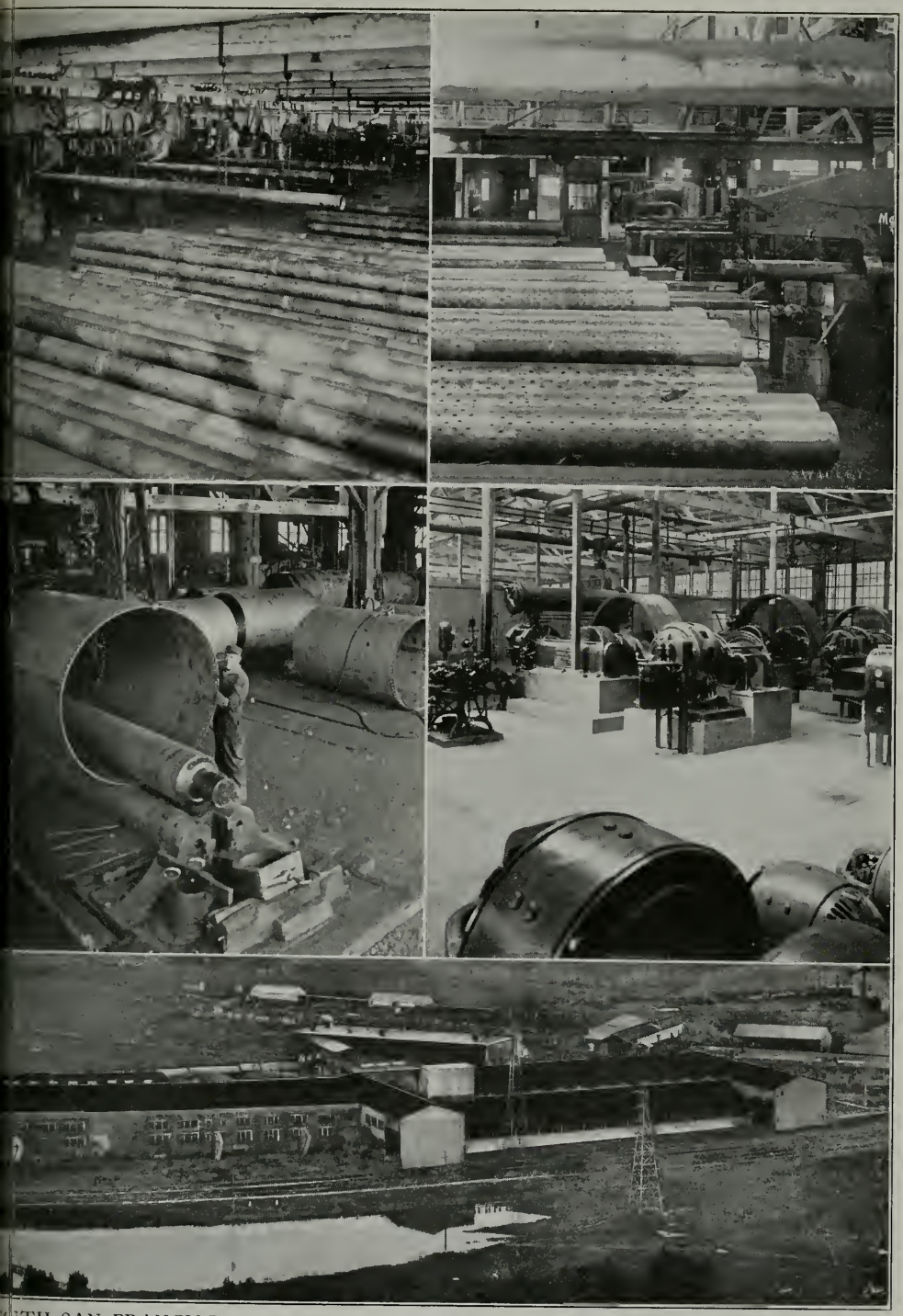
How W. P. & S. Ships by Water



ADVANTAGES OF TIDEWATER LOCATION—*Top—Loading barge at South San Francisco. Center—Towing barge down the bay to steamer dock. Lower—Loading pipe on steamer.*

VIEWS OF VARIOUS DEPARTMENTS AND EXTERIOR OF W. P. & S. PLAN

shop. Making well-casing in the sheet metal department. Water pipe department, showin
right)—General view of heavy plate shop. Smoke stack being assembled in distance. A
Hetch Hetchy line. The roll is completed and section is ready for riveting. Compressor
South San Francisco plant from Bay Shore Highway. The railroad paralleling the plan
into the deep waters of San Francisco Bay.



UTH SAN FRANCISCO—*Top (left to right)—Galvanized corrugated culvert and tank engaged in round seam riveting. W. P. & S. perforated casing. Second row (left to of the heavy plate shop, showing pneumatic hoist handling plate. Rolling 60" pipe for equipment shown here is unsurpassed on the Pacific Coast. Bottom strip—Panorama of n line of the Southern Pacific. A ship channel leads from the basin at the extreme left*

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IT has been aptly said that what a blueprint is to an engineer, a bird's-eye view is to a layman. With this thought in mind, plus the fact that there is no scenic value in a drawing, we present on the cover of this issue an airplane picture of the big South San Francisco plant of Western Pipe & Steel. The sight is a familiar one to those who travel to and from San Francisco by train or Bay Shore highway, as both routes skirt the western side of the property.

Other pictures throughout the magazine show interior and exterior views, and also give a comprehensive exposition of the wide variety of W. P. & S. products. The endeavor is to give readers an adequate idea of the magnitude and production facilities of our South San Francisco plant.

The average number of men employed is 400. The labor turnover is so small as to be almost negligible. Many of the employees have homes at South San Francisco, and have been with the company for years.

From the customer's standpoint one of the most important features here is the huge stock of sheets and plates carried at all times. The average stock inventory shows from 8,000 to 10,000 tons of plates and sheets on hand. This makes it possible for W. P. & S. to fabricate practically every order from stock. Work begins on the average order the day it is booked.

Thus customers avoid the vexations that ensue when manufacturers order material from the East. W. P. & S. has long been noted for quick deliveries.

THE HEAD OFFICE AT 444 MARKET ST., SAN FRANCISCO, IS A BUSY PLACE—*At the right of the picture are offices of the executives of the company, over*

(*Continued from Page Two*)

yard; (7) compressor room; (8) electrical department; (9) office and draughting department; (10) warehouses, three in number; (11) dip sheds.

Within the plant there is also a cafeteria where hot meals are served to employees, and a hospital, with doctor and nurse in attendance.

For handling material the plant is equipped with eleven overhead bridge cranes, one 15-ton industrial crane, and a 10-ton steam yard crane. The machinery and equipment include the latest improved designs in punches, shears, rolls, plate planers, hydraulic presses, hydraulic bulls, etc. The largest of the hydraulic presses is 350 tons capacity. There are eight compression riveters.

The compressor equipment deserves special mention. It consists of four machines for compressing air for guns, air drills, pneumatic hoists, etc., producing 3240 cubic feet of free air per minute.

One of the features that attracts the interest of engineers is a pipe-testing machine, designed by W. P. & S. engineers and built at the plant. It is used for giving a pressure test to every section of pipe before it leaves the plant. It handles pipe of any size up to 72" diameter, and is capable of exerting a pressure of 800 pounds to the square inch.

Two dipping kettles adjoin the heavy plate shop and water pipe shop, one of which is horizontal (4'x40') and the other vertical (7'x36'). In these kettles pipe sections are dipped to coat them with asphalt compound. The compound is kept at a temperature of 360 degrees, and the pipe remains in it until the metal attains the temperature of the bath.

The South San Francisco plant has handled some of the largest orders fabricated on the Pacific Coast, notably the Bay Crossing Division of San Francisco's Hetch Hetchy line, with twenty miles of 60-inch riveted steel pipe.

ooking Market St. Back of the counters are the sales department, purchasing agent's epartment, bookkeeper's and cashier's departments, order department, etc.

The Humane Side of a Great Industry

By Frank A. Corbusier
Insurance Fund Manager, W. P. & S.

If you were to take a trip from Seattle to San Diego and even into Arizona, it would not be unusual to meet employees of Western Pipe & Steel in many places along your line of travel, not only in towns and cities, but in the wild mountainous country, the desert, and in fact any spot where a tank, a stack or gas holder is to be erected, or a pipe line laid.

The plants at South San Francisco, Los Angeles, Taft, Fresno and Phoenix, Arizona, fabricate material for these field forces, in addition to manufacturing other steel products.

The welfare and safety of our employees in this hazardous work is a problem always before us and was recognized several years ago by the organization of a special welfare, safety and insurance department.

Under our plan of self-insurance under the workmen's compensation laws, the head of this department comes in personal contact with all the employees.

Should an employee be disabled, even in a most isolated spot, he is immediately transported to the best surgeon in the locality and no expense is spared in treatment.

All compensation is paid from the San Francisco office, and each case is followed carefully until the man is returned to work.

Rehabilitating the injured and proper placing of men after injury are important features of this work.

At each plant an emergency hospital is maintained where a surgical nurse under a competent surgeon is constantly in attendance.

A physical examination is given every employee who enters our service; the result is a clean, healthy personnel.

A constant campaign of safety is carried on over the entire field of operations.

In addition to compensation for the injured, the Employees Mutual Benefit Association, supported and managed entirely by the employees, takes care of the man when sick and pays a weekly benefit which is most liberal.

This Association has been functioning for many years and is efficient and conscientious in its work.

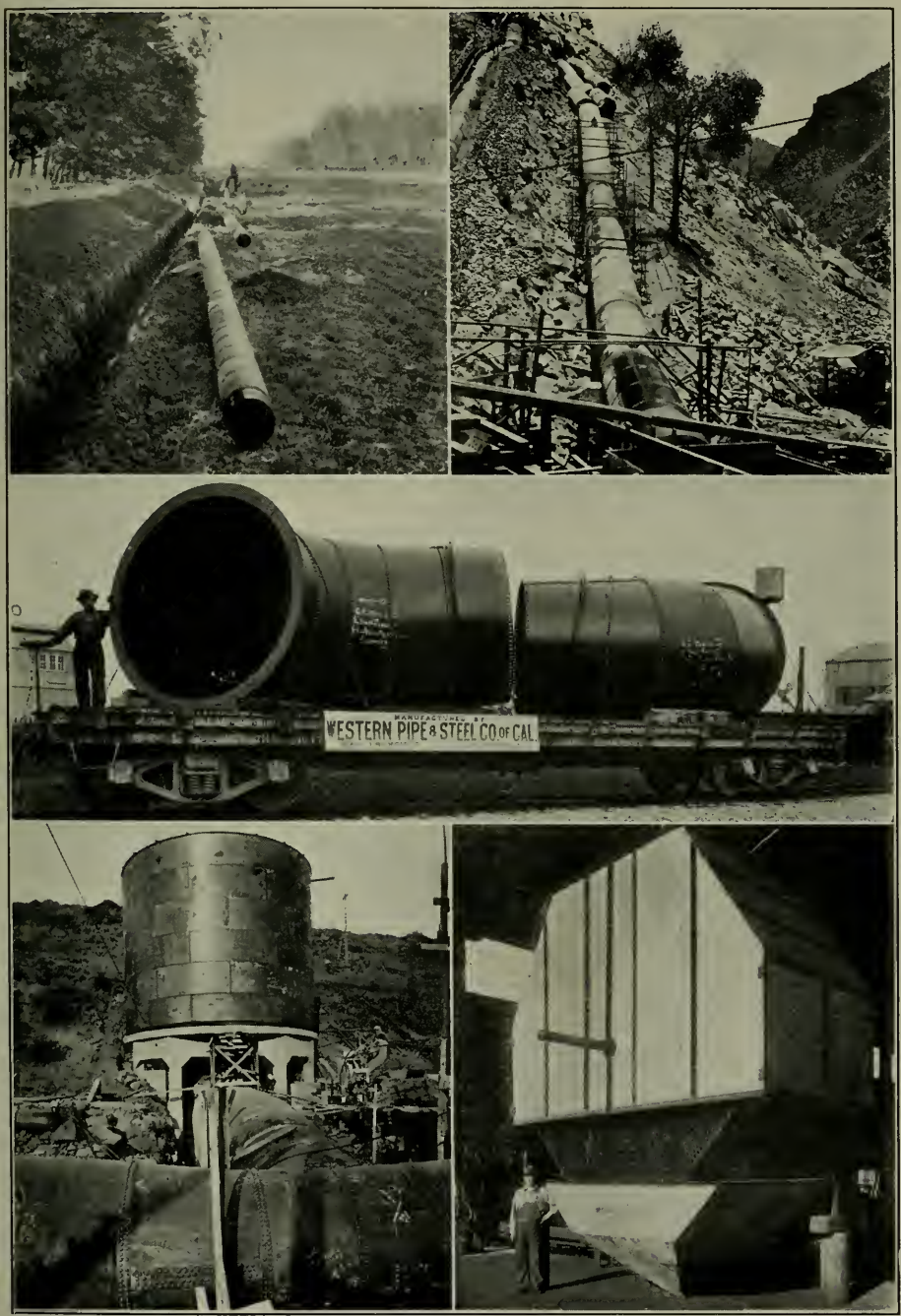
We have a very small labor turnover. A majority of the employees are old-timers, efficient in their work and loyal to the company. This, of course, is an ideal condition.

Loyal and faithful service is recognized by the management. Every employee who has been with the company for a period of six months or more has been given a life and total disability insurance policy for the benefit of his family. Six months' service is rewarded with a $500 policy which increases to $1000 at the end of a year and thereafter increases $200 a year until the sum of $2000 is reached.

This insurance is provided at the expense of Western Pipe & Steel and does not in any manner take the place of or interfere with benefits provided by the compensation laws.

The result is contented, happy, healthy employees, whose efficiency and loyalty prove to the management that our efforts of helpfulness have not been in vain.

Western Pipe and Steel News welcomes the opportunity to exchange with other publications in the same field. The editor has placed a number of such publications on the mailing list, and will be glad to receive suggestions about those that have been (quite unintentionally) overlooked. "Turn and turn about is fair play." We should be glad to be placed on the mailing lists for house organs, bulletins and occasional publications covering our lines.



A WIDE VARIETY OF PRODUCTS FABRICATED AT SOUTH SAN FRANCISCO—*Upper left—10″ soil-proofed water pipe for Bear Gulch Water Co., Menlo Park. Upper right—Installation of heavy penstock for San Joaquin Light & Power Co. Kerkhoff power plant. Center—Giant elbows for Reclamation pumping plant, Sacramento. Lower left—Surge tank for California-Oregon Power Co., Klamath Falls. Lower right—Cement mill equipment for Riverside Portland Cement Co.*

WESTERN PIPE AND STEEL CO. OF CAL.

WESTERN PIPE AND STEEL NEWS

TERRAIN GOVERNS METHOD OF TRANSPORTATION—*Upper—Section of penstock on sleds en route to P. G. & E. Hat Creek No. 1. Center—Up the mountain by flat car and cable. Penstock for Southern California Edison Big Creek No. 2 plant. Lower—Trucking a section to Kerckhoff plant of San Joaquin Light & Power Corp.*

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SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME 1 NOVEMBER, 1924 NUMBER 7

W. P. & S. Plays Important Part in Hydroelectric Development

By FREDERICK S. MYRTLE

Editor-in-Chief Pacific Service Magazine

Official Organ of Pacific Gas & Electric Company

AMONG the spectacular achievements in which the Western Pipe & Steel Company and its predecessor, the Schaw-Batcher Company, of South San Francisco, have played a prominent part during recent years may be noted the immense hydro-electric construction work that the power companies have had in progress throughout the length and breadth of California. Penstock pipe to the amount of tens of thousands of tons in weight has been turned out of the great factory on the bayshore of San Francisco to supply water conduits for mountain power houses whose output in electric energy has done more than any other factor to help development in California, mining, agricultural, industrial.

One power company alone, the Pacific Gas & Electric Company, has installed W. P. & S. steel pipe of the total weight of 10,220,000 pounds during the past eleven years. The first contract of great magnitude was that for the penstock at Drum power house, in the Bear River gorge about nine miles below Lake Spaulding in the Sierra Nevada region. At this development there is a maximum head of 1375 feet and to convey the water from Drum forebay to the power house took a total length of steel pipe amounting to 6,272 feet, or a total weight amounting to 2,919,877 pounds. This pipe, measuring 72 inches at the point of intake and tapering down to 52 inches at the power house, was laid in 1913 and has nobly stood the test of time. Only this year a companion pipe was laid down the steep part of the slope at Drum to take care of the additional water flow from increased storage facilities in process of construction at Lake Fordyce and on Drum canal; this length of pipe measuring 2,491 feet is of the same diameter dimensions as the other and has a total weight of 1,535,000 pounds. Some distance down the valley, the Wise power development is located in Auburn Ravine about a mile and a half below the city of that name. Here the forebay is located upon a hill back of the Nevada Street station at Auburn and to reach the slope above the power house takes a total length of 6,640 feet. This pipe was laid in 1916 and measures 84

California, with only about one-thirtieth of the population of the country, produced last year (1923) more hydro-electric power than any other State in the Union. To be exact, California generated one-fifth the entire total of the United States, and the California production alone exceeded the combined hydro-electric production of the three great States of New York, New Jersey and Pennsylvania. The falling waters of California have been put to the service of its people.—Wigginton E. Creed, President, Pacific Gas & Electric Company.

inches in diameter at the forebay and 66 inches at the power house. Its steel content is 2,720,550 pounds.

Another big contract executed by the Western Pipe & Steel Company was the laying of 3,038 feet of penstock at Stanislaus Power Company situated on the Stanislaus river between Angels Camp and Sonora. This was laid in 1920 and weighed 1,113,924 pounds. It measures 49½ inches in diameter at the forebay and 40 inches at the power house. Other Pacific Gas & Electric Company developments with which Western Pipe & Steel has been identified include the Halsey development near Clipper Gap, seven miles above Auburn, the Spring Gap development on the middle fork of the Stanislaus river and the two Hat Creek plants connected with the great Pit River development whose successful inauguration has been the talk of the engineering world. Pit Number One plant is in full operation, Pit Number Three is now approaching its final construction stages and there will be three more to follow before the chain is complete. So there is yet work for the steel pipe manufacturer in that region.

THE COVER PICTURE—*View looking up to forebay, Hat Creek Power Plant No. 1 of the great Pit River development of Pacific Gas & Electric Co. Penstock fabricated by W. P. & S. at South San Francisco. The total length of this penstock is 1600 feet. Its top diameter is 10 feet, and diameter at power house 8 feet. This is but one of many penstocks built by W. P. & S. for P. G. & E.*

Penstock fabricated by W. P. & S. for Moccasin Creek plant, City of San Francisco Hetch Hetchy project.

Growth of Southern California Edison

By H. W. Dennis, *Construction Engineer, Southern California Edison Co.*

(It is highly gratifying to Western Pipe & Steel that it has been privileged to supply Southern California Edison Company with many of its riveted pipe lines as well as other material. This company feels that it has played a helpful part in the rapid development of the great Edison Company.—Editor.)

THE phenomenal development of the great Southwest has been the subject of comment throughout the world. This has been made possible by the ability of its industries, shops, stores, utilities, etc., to expand in order to keep pace with the constantly increasing demands made upon them. Without this capacity of industry to expand, progress in the community would be impossible.

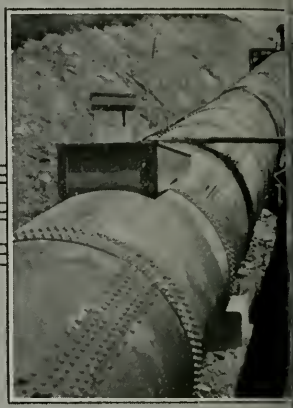
The steady growth of Southern California Edison Company during the last two decades is typical of many industries of the West, although, perhaps, on a much greater scale than the majority.

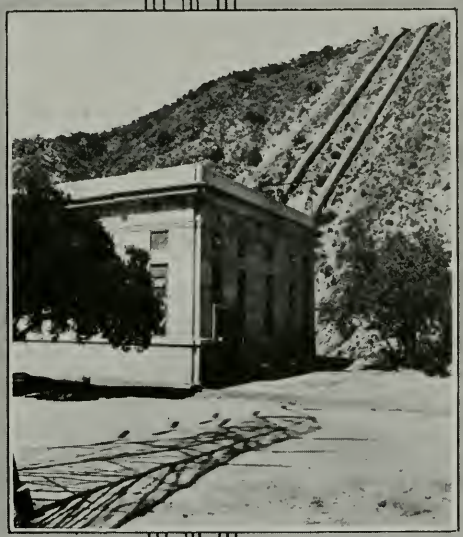
The Edison System had its beginning in 1896 when its total capitalization amounted to only $500,000 and its maximum load was less than 200 K.W. Today after a lapse of less than 30 years its capitalization is over $200,000,000 and it has already carried a peak load in excess of 300,000 K.W. Such a tremendous increase in ability to serve a rapidly growing community has been the result of constant vigilance and keen foresight on the part of the Company officials in planning large future developments that can be placed in service as needed. In the early days when the system was small many plants of only a few hundred K.W. capacity were installed.

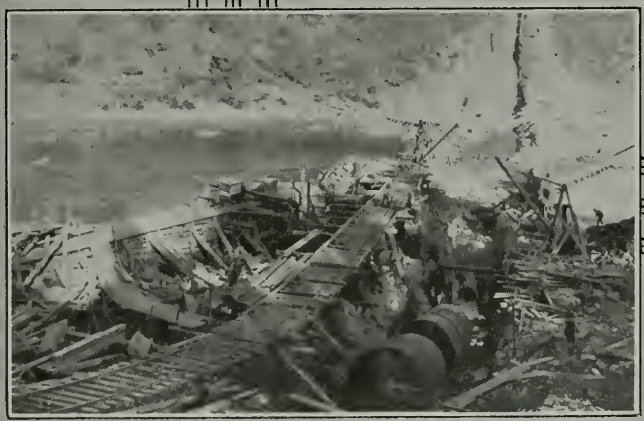
The total generating capacity of the Company is now over half a million horse-power and there is at Big Creek alone in the neighborhood of 200,000 H.P. yet to be developed. Having demonstrated its ability to keep ahead of the rapid expansion of the West, there is no doubt that, when the need arises, this Company will be ready and able to discharge its duty to the community.

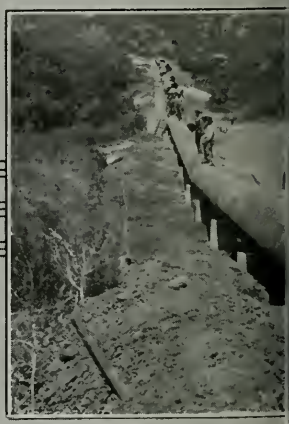
The Edison Company has always endeavored to trade at home and it has been dependent on the support of the local industries for much of its equipment and material.

Installing penstock for Southern California Edison Co.'s Big Creek plant No. 2.



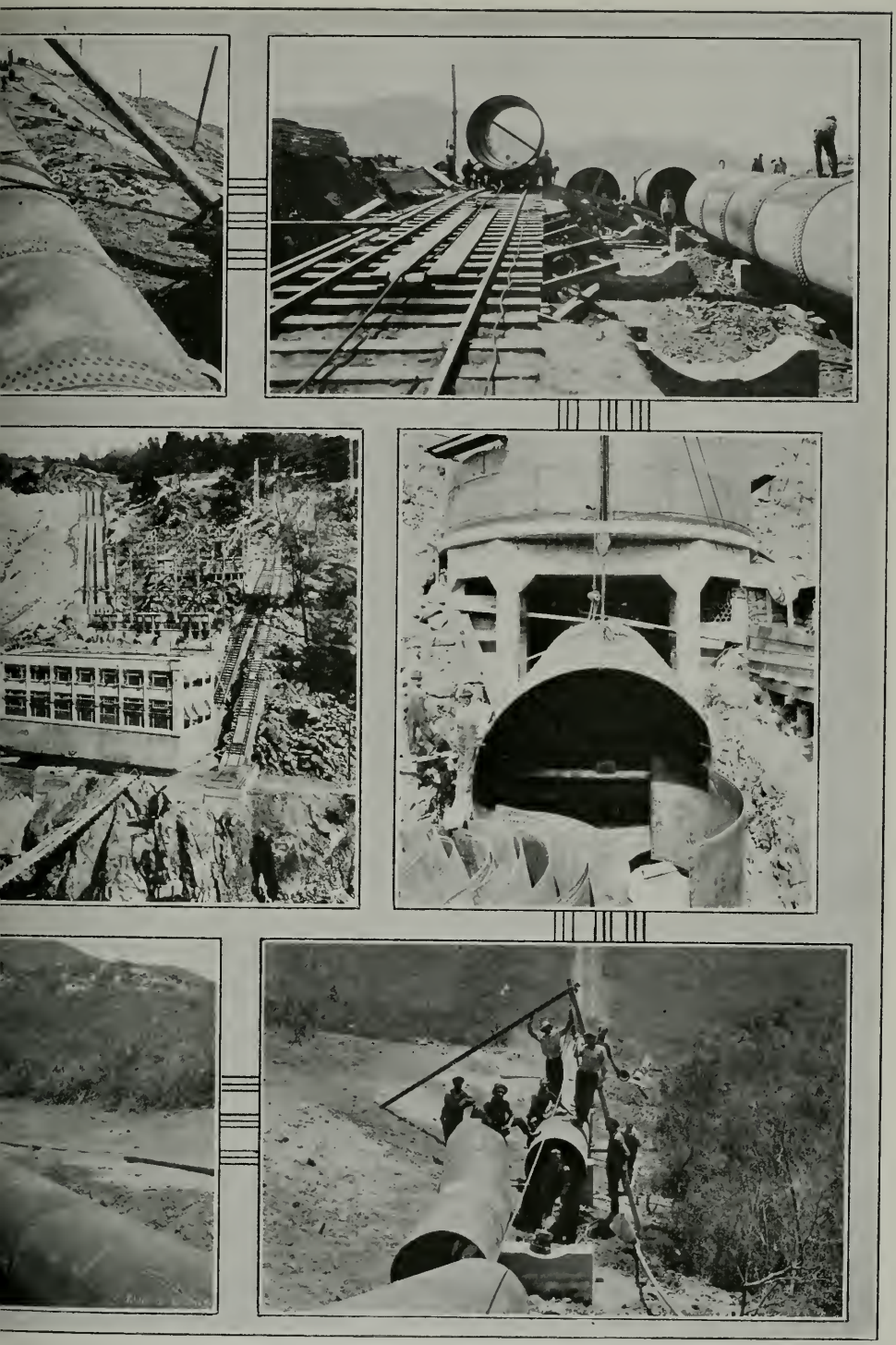






A STORY IN PICTURES. EXAMPLES

UPPER ROW—*Three views of W. P. & S. penstock fabricated for Moccasin Creek pla* $\frac{3}{8}''$ *to* $\frac{9}{16}''$. CENTER ROW (*left to right*)—1—*City of Los Angeles Power Plant No. 2, San by W. P. & S. for Kerckhoff plant of San Joaquin Light & Power Corp.* 3—*Front view differential surge tank and* 14′ *diameter penstock, California Oregon Power Co., Klamat Hetchy project.* 2—*Hell Hole Syphon, San Diego County Water Co., pipe fabricated at L*



'. & S. PENSTOCKS AND SYPHONS

ity of San Francisco's Hetch Hetchy project. Diameter 104" to 98", thickness of plate ta Canyon, showing W. P. & S. penstock. 2—Looking down 3-line penstock fabricated off power house, San Joaquin Light & Power Corp. 4—A close-up showing base of ower Row *(left to right)—1—Red Mountain Bar Syphon, City of San Francisco Hetch plant of W. P. & S. 3—Another view of Hell Hole Syphon.*

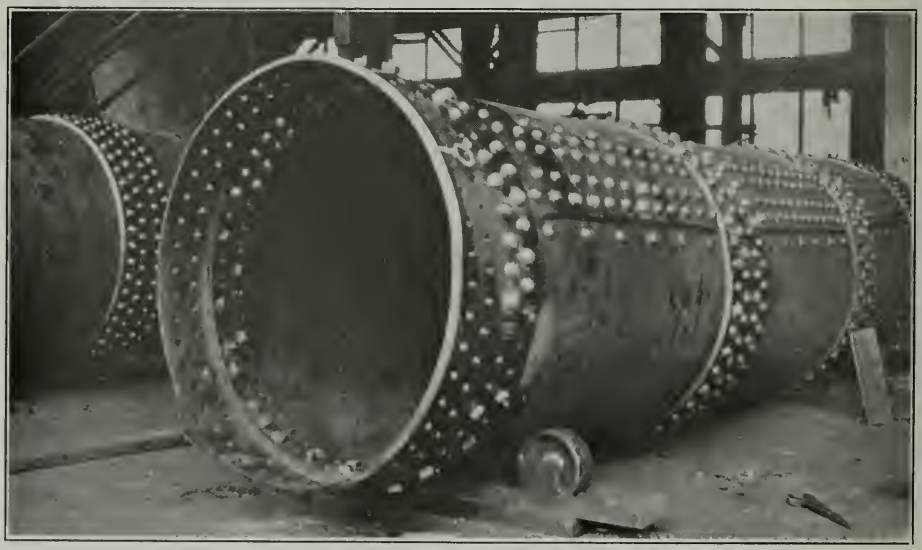
Western Pipe and Steel News
PUBLISHED BY
WESTERN PIPE AND STEEL COMPANY
OF CALIFORNIA
444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

HYDRO-ELECTRIC development on the Pacific Coast, and particularly in California, has been proceeding on such a grand scale, and has been accompanied by such notable engineering achievements during the last two decades, that the eyes of the electrical world have been pretty well engaged in keeping up with achievements in this region. That development will be on an even greater scale during the next decade is apparent in the mere statement that California power companies alone plan to expend $500,000,000 between now and the end of 1934.

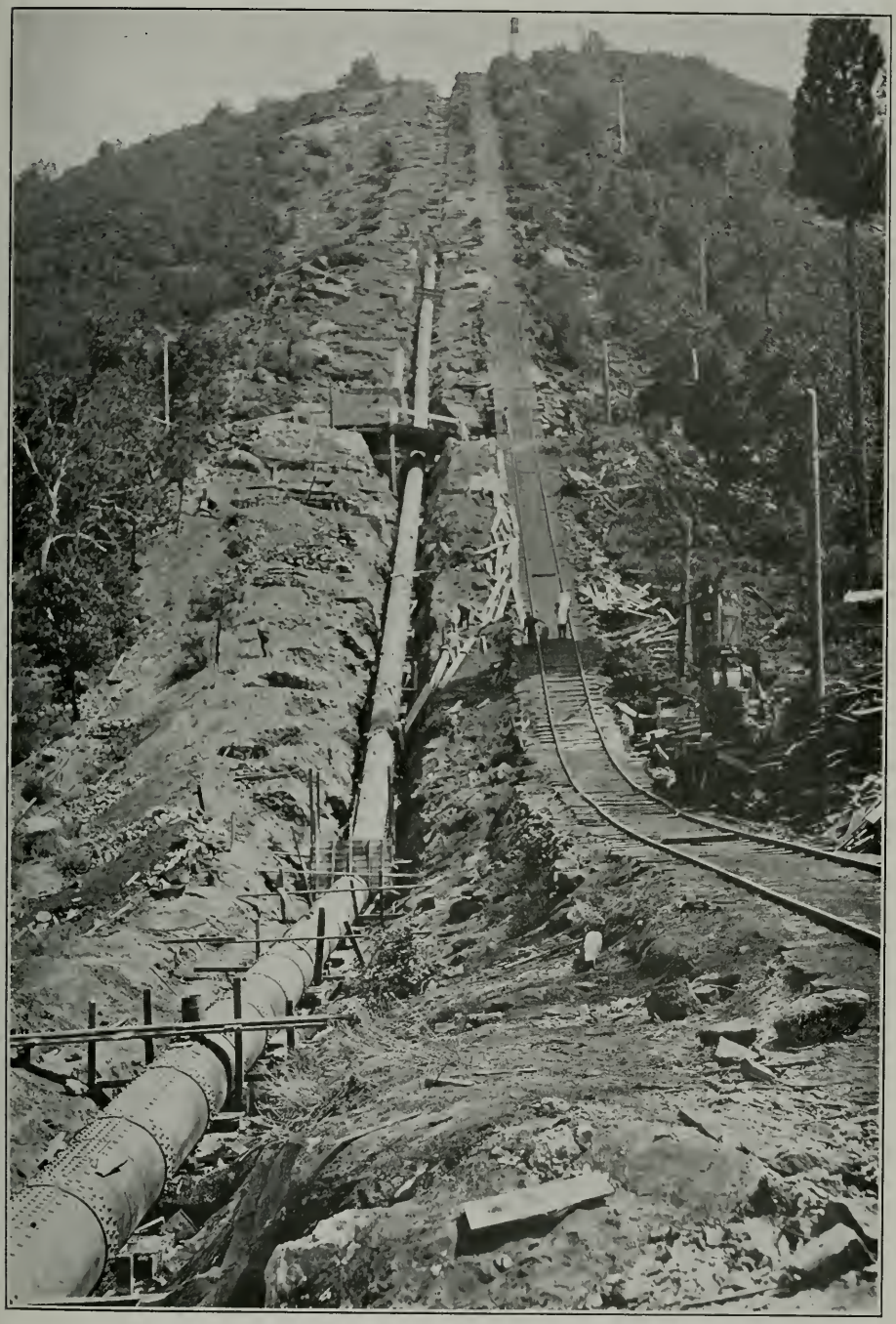
This number of *Western Pipe & Steel News* deals with the great things these companies have accomplished in the past, and the part Western Pipe & Steel has played in that accomplishment. To list the companies for whom Western Pipe & Steel has supplied penstocks or general plate work is to call the roll of all of the great power companies: Pacific Gas & Electric Co., Southern California Edison Co., San Joaquin Light & Power Corp., California Oregon Power Co., Western States Gas & Electric Co., Great Western Power Co., Los Angeles Gas & Electric Co., as well as the great municipalities of Los Angeles and San Francisco.

Our large plants at Los Angeles and South San Francisco have fabricated thousands of tons of steel plates into penstocks that are playing their part in the transmutation of water into electrical energy to light homes, cook meals, furnish heat, run machinery and street cars, illuminate streets and signs, turn the wheels of industry, and perform prodigies of labor for the farmer.

That Western Pipe & Steel has kept pace with hydro-electric development on the Pacific Coast goes without saying. When it is recalled that the first power plant in this region was erected in 1889, and that nearly all the major units have been constructed in the last fifteen years, it is apparent that it has been a task of no mean magnitude to keep abreast of the demands of this giant industry.



Close-up of penstock section for P. G. & E. Drum plant, in the heavy plate shop at W. P. & S. South San Francisco plant.



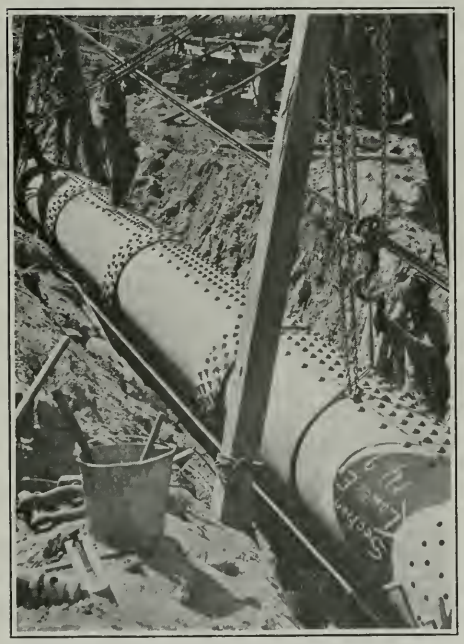
W. P. & S. PENSTOCK FOR SOUTHERN CALIFORNIA EDISON COMPANY—*This penstock was fabricated at our Los Angeles plant for Edison Big Creek power plant No. 2. The Edison Company is one of the two largest hydro-electric power companies in the West and its growth has been phenomenal.*

Pacific Coast Power Resources

(The following is from an article published in the August, 1924, number of the Journal of Electricity, San Francisco, whose editor has kindly authorized its use here. The article bears the signatures of A. H. Markwart, Vice-president in charge of Engineering, Pacific Gas & Electric Co., and H. A. Barre, Executive Engineer, Southern California Edison Co. Both of these men are recognized experts and speak with the highest authority on hydro-electric development.)

"THE hydro-electric resources of the three Pacific Coast states constitute 43 per cent of the water power of the United States, and under economic development will produce 104 billion kw.-hr. annually. Less than 10 per cent of this is developed. The total is sufficient to supply a population of 23 millions under a consumption of 5,000 kw.-hr. per capita, which is nearly five times the present use. The growth of load for this region during the past decade has been 10 per cent per annum, which is 3.5 times the rate of growth of population. California heads the United States in hydro-electric output. . . .

Alder Creek syphon, Western States Gas & Electric Co., near Placerville. Fabricated and installed by W. P. & S.



Field crew installing penstock for Southern California Edison Co., Big Creek plant No. 2.

"The largest system in the West is that of the Pacific Gas & Electric Company with 3,492 circuit miles of transmission at voltage ranging between 30 kv. and 220 kv., fed by 474,550 kw. of plant capacity serving 311,615 consumers, residing in over 54,000 square miles of territory. . . .

"The next largest is the Southern California Edison Company with 2,072 circuit miles at similar voltages, supplied by 497,800 kw. of installed plant capacity. . . .

"When it is stated that a billion dollars will be expended in hydro-electric construction in the states west of the Rocky Mountains in the ensuing ten years, of which $500,000,000 is to be spent in California alone, the figures are so large that the mind can hardly grasp their real significance."

A STRIKING EXAMPLE OF PENSTOCK INSTALLATION IN RUGGED COUNTRY—*Pacific Gas & Electric, Hat Creek Powerhouse No. 1. This penstock is 1600′ long, 10′ diameter at top and 8′ diameter at entrance to turbine. The head is 217′. A notable unit of the Pit River development.*

In the West It's "Western"

With this symbol of craftsmanship Western Engineers, Purchasing Agents, Contractors and Other "Buyers of the Best" have come to associate *Quality* in Fabricated Steel Products

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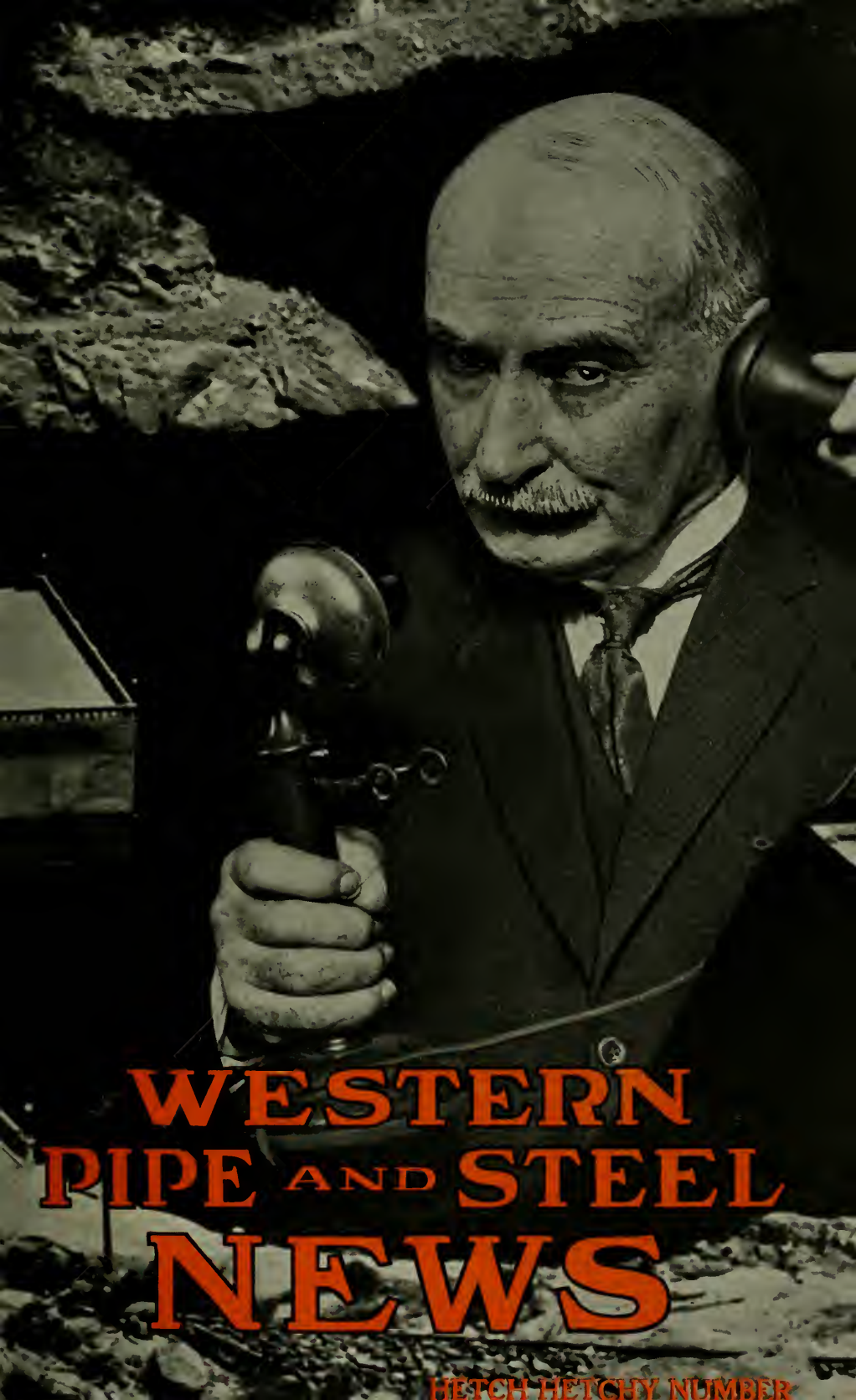
WESTERN
PIPE AND STEEL
NEWS
HETCH HETCHY NUMBER

TO BRING WATER TO SAN FRANCISCO—*The eminently useful in a setting of marvelous beauty. Western Pipe & Steel installation of Hetch Hetchy conduit in the gulches of Cordilleras Canyon. Over such terrain as this, near the East Portal of Pulgas Tunnel, the pipe is carried on steel bents.*

Western Pipe and Steel News

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Hetch Hetchy—San Francisco's Great Water and Power Project

By M. M. O'SHAUGHNESSY

Chief Engineer, City and County of San Francisco

THE Hetch Hetchy Water Supply is primarily a project to bring 400 million gallons of water daily from the Tuolumne River to San Francisco and its vicinity. The points at which water enters the Hetch Hetchy system are at such an elevation that transmission through the entire 156 miles of aqueduct will be accomplished by gravity, and in addition provide a large amount of surplus energy. The combination of a hydroelectric power system with the water supply system is therefore an economical one, and all of the surplus head of water will eventually be used to generate power, totaling about 250,000 H.P.

The source from which the supply is derived is a watershed of 652 square miles in the Sierra Nevada, drained by Eleanor Creek, Cherry Creek, and the upper Tuolumne River.

Water impounded in Lake Eleanor (present development 9.1 billion gallons, elevation 4,660 feet), and Hetch Hetchy Reservoir (67 billion gallons, elevation 3720 feet) will flow in the stream channels to points near their confluence, and will there be diverted into an aqueduct tunnel 18.8 miles long; the head works of this tunnel being at Early Intake at elevation 2326 and the lower end at Priest Reservoir, the forebay for the Moccasin Power Plant, the flow line of which is 2240 feet elevation.

After release from the power plant, the water will enter the foothill aqueduct tunnel at elevation 888, and continue to San Francisco, flowing by gravity. The aqueduct from Moccasin Creek to San Francisco will be 134 miles long. Of this length, 65 miles will be in tunnels, through the Sierra Nevada foothills, the Coast Range and the hills of the San Francisco Peninsula. The remaining 69 miles will be steel pipe. The terminus of the aqueduct will be the Amazon Reservoir (elevation 248) in San Francisco.

O'SHAUGHNESSY DAM

The O'Shaughnessy Dam, completed in 1923, is located at the lower end of Hetch Hetchy Valley, 168 miles from San Francisco along the aqueduct line, and creates the Hetch Hetchy Reservoir. The dam is of the gravity type, arched in plan. The principal dimensions are as follows:

Elevation of original stream bed	3,500	ft.
Height of crest above stream bed	226.5	
Height of water surface above stream bed	220	
Depth of lowest point of foundation below stream bed	118	
Radius of arch	700	
Length of roadway on crest	700	
Width of roadway on crest	15	
Volume of concrete	396,000	cu. yds.

This dam is 30 feet higher than the Standard Oil Building, the highest building in San Francisco.

The great bulk of the dam is of "cyclopean masonry," or concrete with large stones or "plums" embedded.

The spillway is of the siphon type, with a total length of clear openings of 180 ft. 6 in.

There are twelve outlet conduits, each with 3 separate control valves. Six conduits, each five feet in diameter, are arranged in pairs at three levels, to discharge the water (in quantities up to 3000 second feet) which under certain conditions of river flow is not to be impounded but permitted to pass the dam for the use of irrigation districts in the lower reaches of the Tuolumne River. The other six outlets are each 3 ft. in diameter, in two groups of three, and will discharge the water for San Francisco's domestic supply. These smaller outlets will ultimately discharge directly into the aqueduct tunnel to be constructed in connection with the future power development at Early Intake, while the water for irrigation may flow directly down the bed of the river.

The dam is intended to be raised, at some future time, from the present 226.5 ft. height to an ultimate height of 312 ft. above the stream bed. In order that such addition may be constructed without further stream diversion or difficult excavation, the foundations for the ultimate dam were built with the initial development in the downstream side of the existing dam.

MOUNTAIN DIVISION TUNNELS

At Early Intake, twelve miles downstream from Hetch Hetchy Dam, the 18.8-mile tunnel aqueduct to Priest Reservoir begins. Its excavation was completed in 1923, and the lining is completed with the exception of a short stretch of floor now being placed.

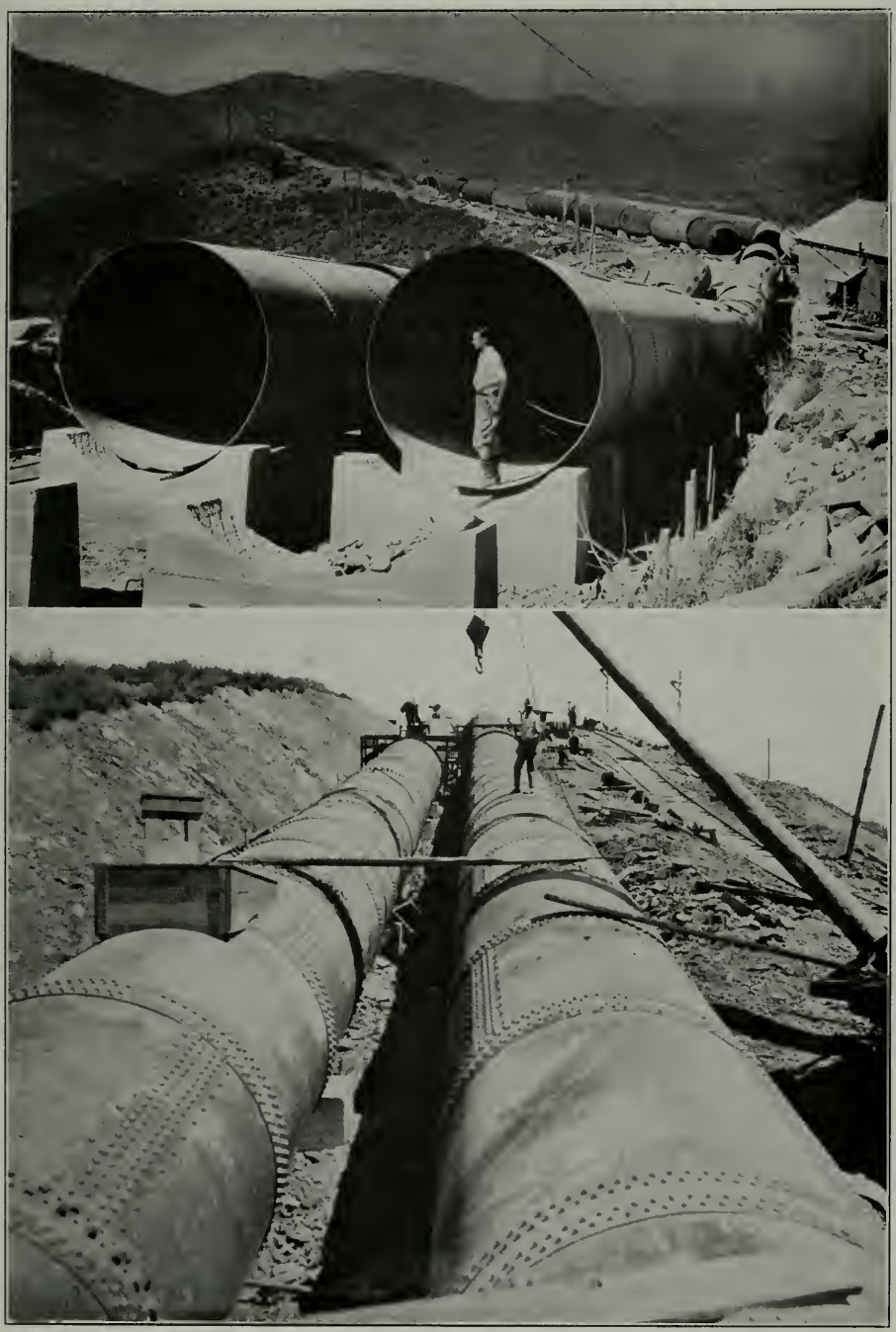
The tunnel has a uniform slope of 1.55 feet per 1000 feet, and is designed to carry 400 million gallons daily. There are two standard sections. For about six miles, the rock is hard and dense. The section in this part of the tunnel has an area of 167.8 sq. ft., within the neat line of excavation, and the tunnel is not lined. The shape of the cross section is nearly square. The remainder of the tunnel, while in solid rock, is in less stable material, and is concrete lined, with a minimum thickness of six inches. The tunnel is of the horseshoe section with an area inside the lining of 87.94 square feet. The lined and unlined tunnels are designed to operate under pressure, the hydraulic grade line being above the tunnel, on a slope of 1.22 feet per 1000 feet of length.

PRIEST RESERVOIR

Priest Reservoir, the forebay of the Moccasin Power Plant, is formed by a dam across Rattlesnake Creek. The dam, 145 feet in height, consists of a concrete core wall to bedrock, a rock-fill downstream toe formed by the spoil from the Priest tunnel heading, and a rock-fill upstream toe with riprap paving, with the upper and interior portion adjacent to the core wall a hydraulic fill. The crest elevation is 2245 feet, length along crest 1100 feet, length from upstream toe to downstream toe 700 feet, volume of the dam 734,000 cubic yards, and capacity of the reservoir 800 million gallons or 2500 acre feet.

POWER TUNNEL AND PENSTOCKS

The water from Priest Reservoir will pass to the Moccasin Power Plant through a tunnel 5950 feet long, of horseshoe section 13 feet in height and width inside of lining. Three 104-inch steel pipes will extend back in the tunnels to the surge chamber. Three 104-inch butterfly valves are installed at the tunnel portals. Initially, one of the lines will terminate at this point and two lines extend down the hill a short distance to a point where each will branch into two lines, one for each of the four power units. These four pipes are each 66 inches in diameter below the Y branch, reducing in size until at a point just back of the power house they are 54 inches in diameter and $1\frac{5}{16}$ inches in thickness. At the power house, each pipe again branches into two 36-inch pipes leading to the separate wheel nozzles.



These pictures illustrate the magnitude of the penstock work fabricated by Western Pipe & Steel for the Mountain Division of the Hetch Hetchy project, described in Mr. O'Shaughnessy's article. These twin pipes carry water down to the turbines of San Francisco's Moccasin Creek Power Plant.

The third line will be extended similarly from the valve at the tunnel portal, when the two additional units, for which the power plant has been designed, are installed.

The slope length of the penstock line is 6025 feet, and the penstock pipes for the four power units will contain about 11,948,000 pounds of steel. The riveted pipe was manufactured by the Western Pipe and Steel Company of California, under contract. The installation is being done directly by the City.

MOCCASIN POWER PLANT AND TRANSMISSION LINE

The power plant machinery is ultimately to comprise six main generating units with auxiliary apparatus; four units are being installed at this time. These units are each of 20,000 KVA capacity, with direct-connected exciters, and are driven by two impulse waterwheels, of combined capacity of 25,000 H.P., overhung on the shaft on opposite sides of the generator. The generator speed is 257 revolutions per minute. The effective head of water at the waterwheel nozzles will be 1250 to 1275 feet when operating under full load.

A double circuit transmission line of 154,000 volts to San Francisco is being built, occupying the right of way of the Hetch Hetchy Aqueduct in the San Joaquin Valley, and paralleling it more or less closely elsewhere.

Surveys have been made for tunnel and pipe lines through the Foothill, San Joaquin Valley and Coast Range Divisions. Work on the tunnels and shafts will probably begin in 1925.

The Moccasin Power Plant will be ready for operation in the spring of 1925. It will have a 24-hour continuous capacity of 52,500 K.W.

AQUEDUCT TO IRVINGTON

From Moccasin Creek west, the aqueduct will consist of 17 miles of tunnels through the Sierra Nevada foothills, 45 miles of heavy steel pipe through the San Joaquin Valley, and 31 miles of tunnels through the Coast Range to Irvington.

A short section of the Foothill Division has already been constructed. This is a steel pipe, known as the Red Mountain Bar siphon, 770 feet long, beneath the Don Pedro Reservoir of the Modesto Turlock Irrigation District on the Tuolumne River. The pipe is 9 feet 6 inches in diameter, lined with cement mortar to a net diameter of 9 feet 1½ inches, and encased in concrete. The steel plates are $\frac{9}{16}$ to ¾-inch thick, with triple-riveted butt joint with two cover plates in the longitudinal direction and double-riveted butt joint with a single cover plate at round seams. This pipe was manufactured by the Western Pipe and Steel Company and installed by the City's forces.

BAY CROSSING DIVISION AND PULGAS TUNNEL

The Hetch Hetchy Aqueduct crosses San Francisco Bay at Dumbarton Strait. In order to make available water from sources already developed in Alameda County, the building of the aqueduct from Irvington across the Bay to Crystal Springs Reservoir has been undertaken in advance of the intermediate divisions. A steel pipe line, 60 inches in diameter and 19.4 miles long, is being constructed from Irvington to a point three miles west of Redwood City. The 60-inch riveted steel pipe is of plate varying in thickness from $\frac{5}{16}$-inch to $\frac{7}{16}$-inch, involving about 17,000 tons of steel. From a point near Irvington at elevation 52 feet, the pipe is buried for a distance of 6 miles, gradually descending to the edge of the salt marsh near Newark. It is then carried over the marsh on a timber pile trestle, 1.7 miles to Newark Slough. The crossing of the slough will be by a cast iron submarine pipe 42 inches in diameter, about 400 feet long. From Newark Slough to the east shore of Dumbarton Strait, 1.4 miles, the 5-foot steel pipe will continue over the marsh on trestle. The navigable channel at Dumbarton Strait will also be crossed by a 42-inch submarine siphon, 2800 feet long, ending at a concrete caisson in the Bay. From the caisson the 60″ steel pipe will be laid on a steel bridge, 3875 feet to the west shore of the bay, thence on trestle 2700 feet to the Bay-Pulgas

pump station. From there on the pipe is buried, continuing at a low elevation through Redwood City. The westerly 2.1 miles of the line pass through hilly country in and near Cordilleras Canyon and the pipe is alternately buried and supported on steel bents over the gullies. In this section, it rises to an elevation of 278.5 feet at the west end, where it connects to Pulgas Tunnel.

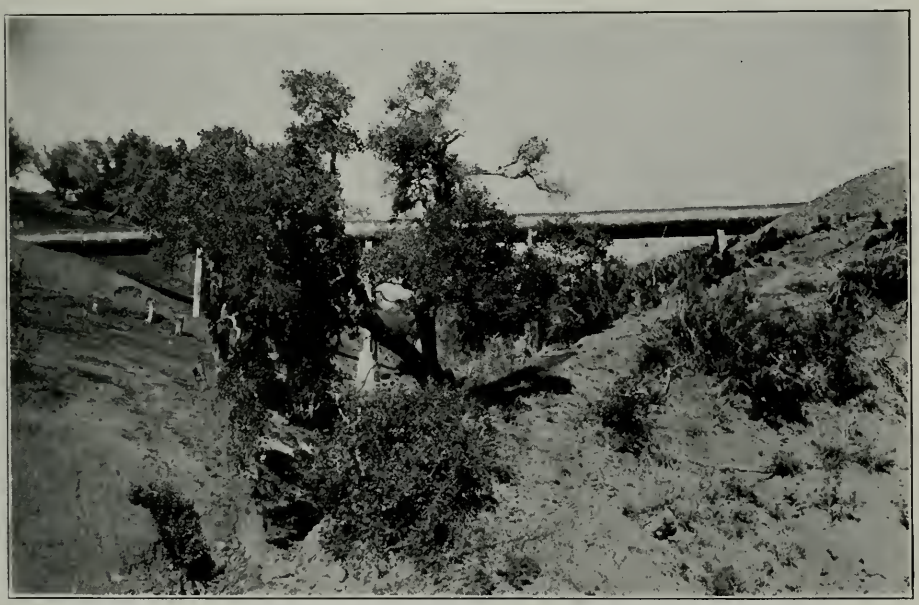
The steel pipe is being manufactured and laid by the Western Pipe and Steel Company under Contract 90, for an estimated price of $2,231,661.25. Pipe laying was begun on the west side of the Bay on October 20, 1923.

Pulgas Tunnel, which for the present forms the westerly end of the aqueduct, was completed in May, 1924. It is a 10 ft. 3 inch concrete lined tunnel, 8,676 feet long, and similar in design to those in the Sierra Nevada. The contract price was $738,429, and its construction required two years.

All engineering work on the Hetch Hetchy Water Supply is done by the Bureau of Engineering of the City and County of San Francisco, under the direction of M. M. O'Shaughnessy, City Engineer.

THE COVER

The cover of this issue of WESTERN PIPE AND STEEL NEWS *carries a striking character study of M. M. O'Shaughnessy, City Engineer of the City and County of San Francisco, and a bird's-eye view of O'Shaughnessy Dam, which impounds the waters of Hetch Hetchy. The ceremonies attending the dedication of the dam, which will stand for centuries to come as a monument to the engineering genius of its creator, were most impressive. Mayor Rolph, Former Senator James D. Phelan, members of the Board of Supervisors and Board of Public Works, and noted engineers and citizens from far and near attended the dedication, which took place July 7, 1923. A plaque bearing the inscription, "O'Shaughnessy Dam," was placed over a fountain on the crest of the dam.*



Hetch Hetchy pipe line crossing one of the picturesque gulches west of Redwood City on steel stilts; a W. P. & S. installation.

FABRICATION, TRANSPORTATION AND INSTALLATIO

Upper row (left to right) 1—Rolling steel plates into circular form at South San Franci sections are tested before dipping. Second row (left to right) 1—Loading pipe on barge in the field by motor truck after landing from barge. 3—Pipe along line of trench. Third operations. 3—Caulking field joints. 4—Applying pressure test to pipe after installation. installation on the marshes near Newark, where the pipe is laid on trestle. Pipe sections

TCH HETCHY PIPE BY WESTERN PIPE AND STEEL

mpleted 32-foot sections. 3—W. P. & S. hydraulic testing machine, with which pipe San Francisco plant of W. P. & S. for shipment to Redwood City. 2—Distributing pipe to right) 1—Caterpillar crane placing pipe in trench. 2—Pipe in place, ready for final operation backfilling the trench begins. Lower strip—Panoramic view illustrating veyed to location on push cars handled by a gasoline car running along the trestle.

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THE biggest and most important enterprise ever initiated by the City and County of San Francisco is the Hetch Hetchy project. When San Francisco decided to bring a huge supply of water and power from the Sierra Nevada mountains, her public servants planned the undertaking on monumental lines and proceeded to carry it out on a scale worthy of a great metropolis. Fortunately, San Francisco has a City Engineer who thinks and works in a big way. The Hetch Hetchy project will be an everlasting memorial to M. M. O'Shaugnessy.

Only those who have visited Hetch Hetchy have an idea of the bigness of the project. Engineers may visualize it by reading a technical description, but even they must see it to appreciate its magnificent scope. There is a beauty and a grandeur about Hetch Hetchy not always associated with engineering works. That man must be totally devoid of emotion who is not thrilled at the first sight of O'Shaughnessy Dam.

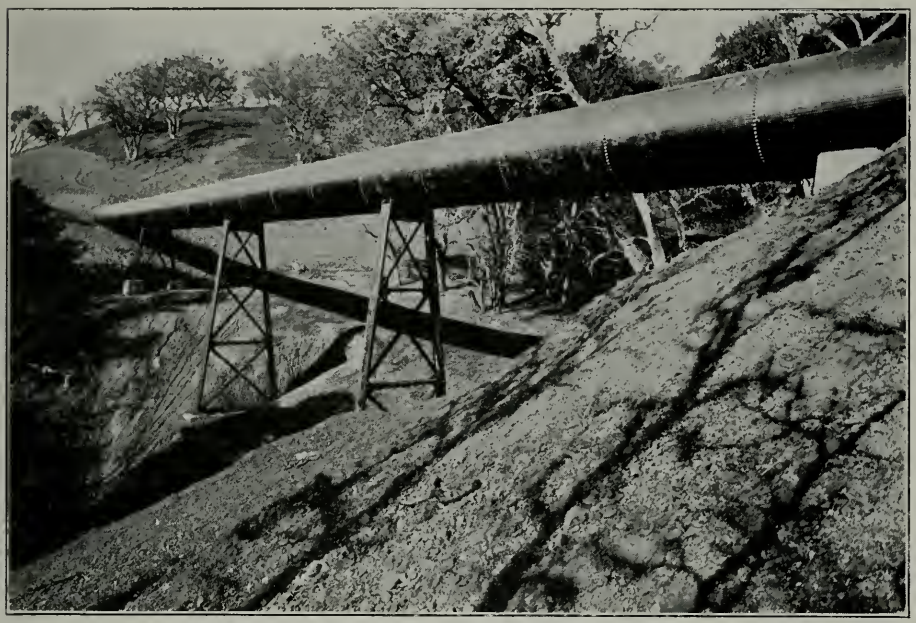
If the man who makes two blades of grass grow where only one grew before deserves the gratitude of his fellow-men, what shall be said of those that invade the mountain wilds and subject the forces of Nature to the beneficent purposes of a great community?

Western Pipe & Steel Company of California confesses a strong feeling of pride in the fact that it is taking a part—no small part—in the execution of the Hetch Hetchy project. Miles of heavy pipeline, gigantic penstocks—these have been the W. P. & S. contribution thus far to the great municipal water supply of San Francisco.

Those who have not yet had an opportunity to see the Hetch Hetchy project may estimate something of its scope and measure the importance of the part Western Pipe & Steel has played, by studying the articles and the pictures presented in this issue.

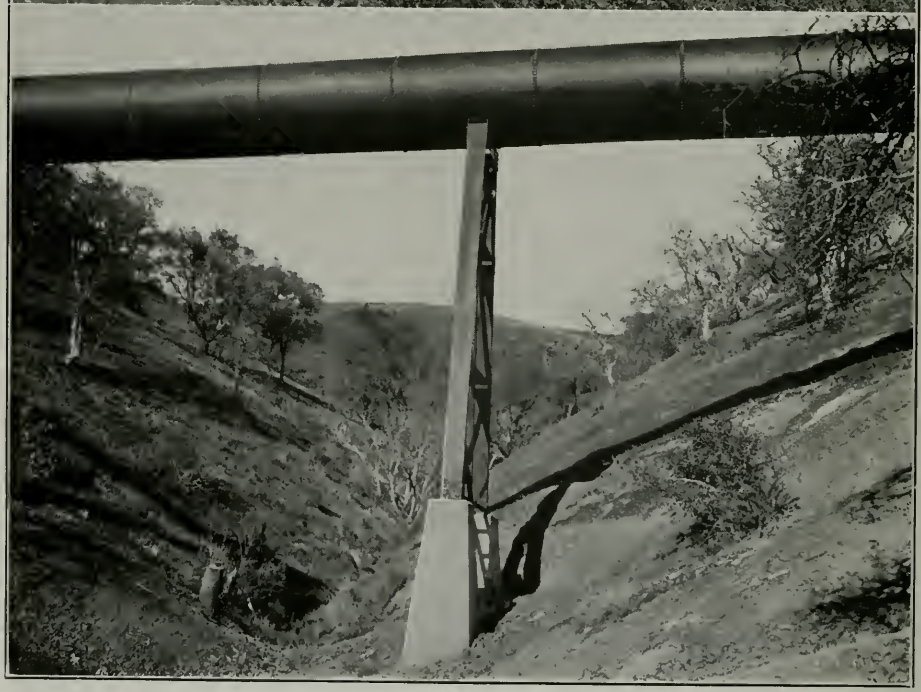
For the words of praise volunteered by San Francisco's municipal department of engineering, this company is deeply grateful. The association has been a pleasant one, entirely free from misunderstandings. It is more than merely gratifying—it is inspiring, to work with big men for a great city.

Huge Y-branches fabricated at South San Francisco by W. P. & S. for Moccasin Creek Power Plant penstock, Mountain Division of the Hetch Hetchy project.



Hetch Hetchy Pipeline in the San Mateo hills approaching Pulgas Tunnel, which will convey the water into Crystal Springs Reservoir.

Many glimpses of the Hetch Hetchy Line such as this may be had from the highway west of Redwood City, where the pipe crosses a score of ravines.



Illustrations of Western Pipe & Steel installation near the western end of the Bay Crossing Division. This work is described in Mr. Eckart's article on the opposite page. The pipe is 5 feet in diameter, and has a maximum carrying capacity of 50,000,000 gallons of water every 24 hours.

Hetch Hetchy Bay Crossing Division

By N. A. Eckart
Chief Assistant Engineer, Hetch Hetchy Project

THE Bay Crossing Division of the Hetch Hetchy project extends from what will be the Irvington Gate House, to be located at the West Portal of the Coast Range Tunnel, to the outfall of Pulgas Tunnel, where the water will discharge into Crystal Springs Reservoir.

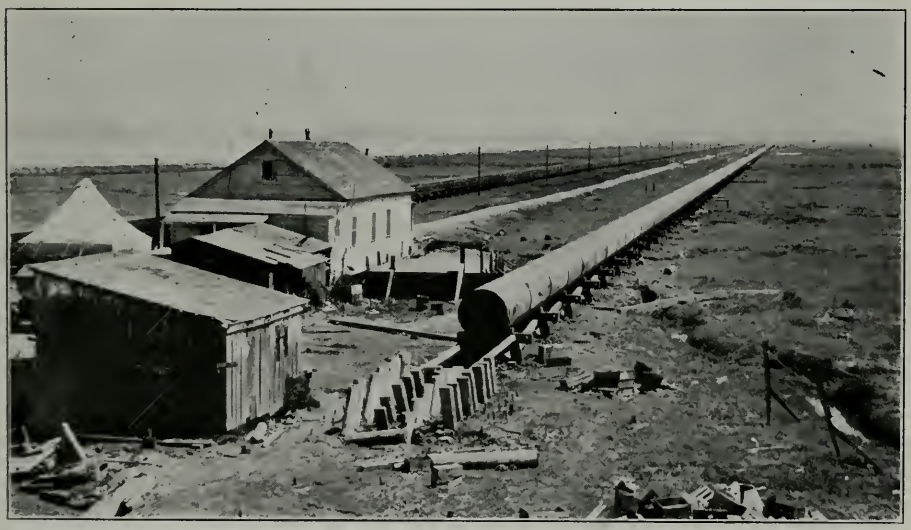
The present installation will have a capacity of 42,000,000 gallons daily under gravity flow from Hetch Hetchy sources, discharging into Crystal Springs at elevation 293.5. Immediately upon completion of the Bay Crossing Conduit in the next few months, it will be utilized by Spring Valley Water Company, under an agreement with the City, to convey water from its Alameda properties to Crystal Springs Reservoir.

The Bay Crossing Conduit as now under construction comprises 19.4 miles of 60″ inside diameter riveted steel pipe, 3200 feet of 42″ submarine type flexible joint cast iron pipe across Newark Slough and the channel at Dumbarton Straits, and 8675 feet of 10′ 3″ diameter concrete-lined tunnel, together with 332 feet of reinforced concrete pipe of the same diameter.

The Bay Crossing Division is being constructed in advance of the intervening sections of the Hetch Hetchy Aqueduct in order to increase immediately the available water supply for San Francisco. This unit is to be completed April 1, 1925.

The first construction undertaken on the Bay Division was the Pulgas Tunnel, the total contract price for which was $738,429.

The next important contract to be let was that for the construction of the steel pipe which constitutes the entire conduit from Irvington to the East Portal of Pulgas Tunnel, with the exception of the submarine pipe across Dumbarton Channel and Newark Slough. The total length of pipe involved is 102,740 feet, or 19.4 miles. This was awarded to the Western Pipe & Steel Co. at an estimated cost of $2,231,661.25. The con-



Hetch Hetchy pipe line, looking east from Newark Slough. The line is carried on trestle over the marshes.

tract included trenching, backfilling, etc., on a unit price basis.

The pipe is all 60″ inside diameter, double lap riveted. It is made up in the shop normally with four 8′ courses. All pipe was tested in the shop before dipping, and made tight. After that it was dipped vertically in a bitumen enamel.

The trench was excavated with a bottom width of 6′, with one to six side slopes, the average depth being 7′ to 8′. All of the trench with the exception of a section in the Cordilleras Canyon, where it was steep sidehill work, was excavated with draglines. As much as 700 feet of trench, averaging 2 yards per foot, was excavated in two 8-hour shifts with one machine.

Hetch Hetchy pipe line west of Dumbarton Bridge, on the Ravenswood marshes.

The pipe was placed in the prepared trench by means of a caterpillar-type traveling crane. Each section as placed was entered into the adjoining section previously laid and pinned. This was followed by crews doing the bolting and laying up, riveting and caulking. Each of these operations followed at such rate as to keep up with the laying of the pipe, which was at the rate of eighteen to twenty sections per day, corresponding closely to the rate of manufacture.

After laying, the pipe was tested to the same pressure as in the shop test (approximately 25% over static).

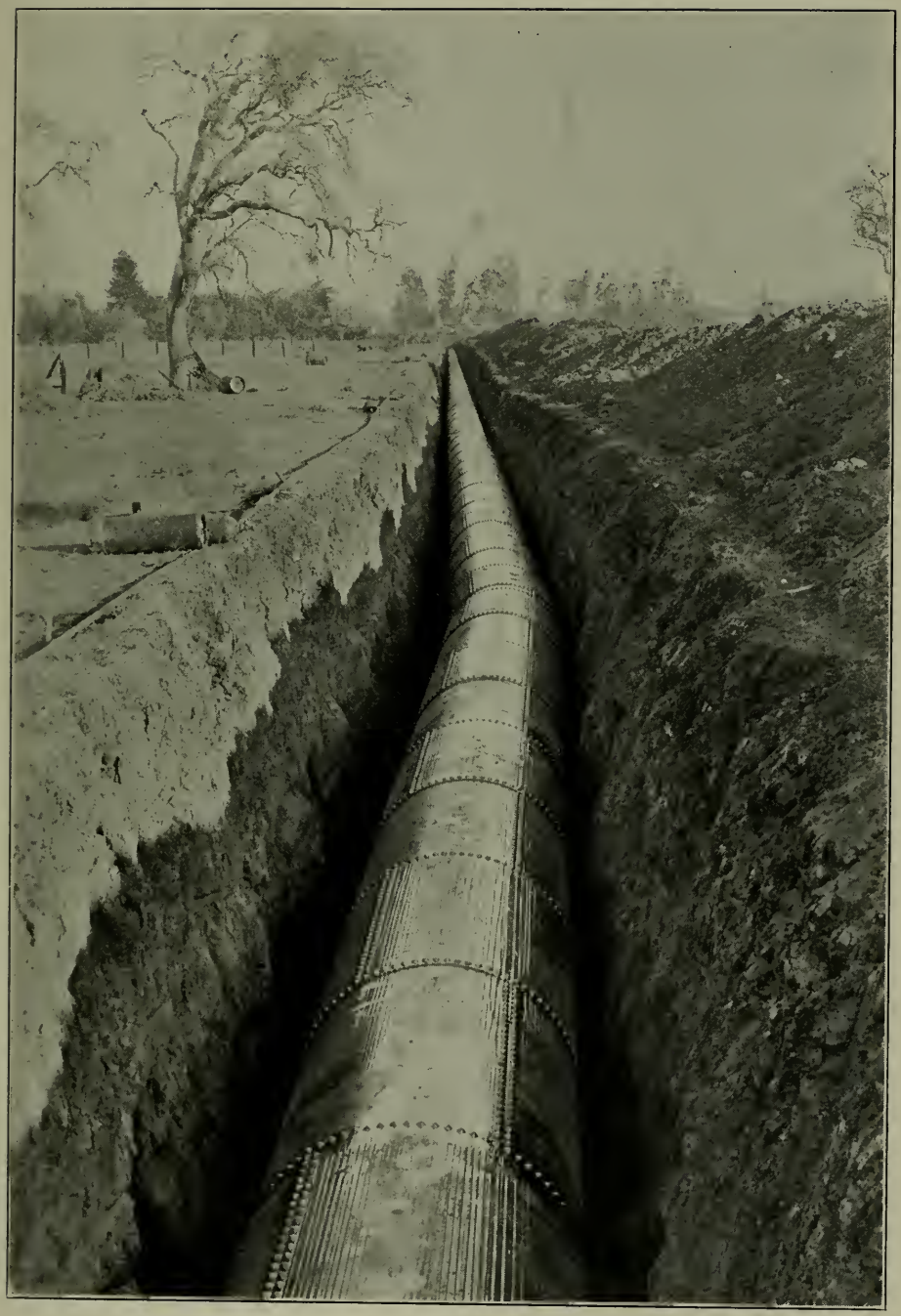
Backfilling was done by means of a piece of equipment specially designed for this job, consisting primarily of a power scraper, operated on an overhead track, supported by a truss, spanning trench and spoil bank; the whole machine being capable of moving longitudinally along the trench on its own power.

Over the marshes the pipe is supported on timber pile trestle work, the aggregate length of the trestle work approximating 20,000 feet. The contract price for this trestle work was $167,548.

In the upper part of the line in Cordilleras Canyon the pipe crosses a number of small gulches. At these points it is supported on steel trestle bents on concrete piers.

The fabrication work on the pipe was excellent, the rivet holes all coming very fair, and the pipe as manufactured fitted the lines and grades as established in the trench to a nicety.

On the Redwood City side of the Bay, between the shore and the deeper part of the channel at Dumbarton Straits, where the submarine pipe will be laid, the 60″ riveted steel pipe being fabricated by the Western Pipe & Steel Co. will be carried on a steel bridge for a distance of 3875 feet. The bridge is a through riveted truss type, consisting of 36 spans, each 105 feet in length, supported on piers on 107′ 5″ centers. The bridge is designed to carry two lines of pipe.



HETCH HETCHY CONDUIT IN TRENCH—*This picture illustrates the way in which Western Pipe & Steel installed the 60″ riveted steel pipe near Redwood City. The total mileage of this pipe in the Bay Crossing Division is 19.4. The methods of fabrication and installation are described in Mr. Eckart's article.*

WESTERN PIPE AND STEEL NEWS

WESTERN PIPE & STEEL HAS FABRICATED MANY MILES OF RIVETED STEEL PIPE FOR LOS ANGELES—*This picture shows one of the important 36" mains, which is carried on a trestle along the river embankment. This is but one of many large trunk lines we have built for the city.*

Western Pipe and Steel News

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Why the City of Los Angeles Uses Riveted Steel Pipe

By WILLIAM MULHOLLAND

Chief Engineer, Bureau of Water Works and Supply

RIVETED steel pipe has been in general use in the distributing system supplying the City of Los Angeles, both while under private ownership and more recently under municipal ownership. The first riveted steel pipe was installed in Los Angeles in the year 1886, while prior to that date riveted sheet iron pipe was in general use. The year 1886 marks the period in which steel was generally put into commercial use for the fabrication of water pipe as well as other purposes. The first steel pipe installed in the City of Los Angeles was of Swedish manufacture. All the riveted steel pipe as installed in the distributing system is of local manufacture as to fabrication.

In 1915 the San Fernando Valley was incorporated into an irrigation district and a complete high pressure steel pipe irrigation system was designed by the writer as Chief Engineer of the Department of Public Service, and this system was completely installed, at a cost of three millions of dollars. The system, as provided for under the bond issue, consisted of some 300 miles of pipe line, 200 miles of which are riveted sheet steel varying in diameter from 8″ to 78″. This system, since that time, has been greatly enlarged by the addition of a great many miles of from 6″ to 16″ tie lines which follow new streets throughout this area. This system is operated under varying heads up to 525 feet.

To summarize the total mileage of riveted steel pipe in this district as of the present time, it might be stated that there are 239.2 miles of from 6″ to 27″ diameter pipe and 39.4 miles of pipe varying from 30″ to 78″ in diameter.

The use of riveted steel pipe in the main portion of the city is generally confined to large trunk lines from 24″ in diameter up. Where soil and drainage conditions are good the use of riveted steel for trunk line construction is favored by this Department, due to the fact that the trunk line is usually operated under a high head and steel for this reason is considered more economical as well as involving less risk, as these lines generally traverse a well-developed portion of the city, acting as a booster or feeder to the entire grid system. It is further a fact which has been developed over a series of years in the use of riveted steel pipe by this Department, that where the same is laid in streets which are improved by a permanent class of paving, conditions generally are materially bettered for the prolonged life of this type of construction. With the exception of a small area in the Palms District, the entire City of Los Angeles is served with water by its municipally owned plant. Within this area there is a wide variation in elevation extending from sea level in the harbor district to 900 feet in elevation on the north rim of the main portion of the city. This great difference in elevation necessarily divides the city into various

zones of pressure. This fact in itself has led the Department to use riveted steel pipe for trunk line construction.

The lengths of these various trunk lines will vary from 3 to 15 miles each and the head or pressure under which they operate is stepped down into the various zones by means of pressure regulators. The standard as adopted by this Department in the use of riveted steel pipe for various diameters is as follows:

Six-inch pipe is of fourteen gauge metal; eight-inch pipe is of twelve gauge metal; and the twelve to eighteen-inch diameter pipe is of ten gauge metal.

The pipe of these various diameters above mentioned is of the taper or drive joint type. Pipe of twenty inches diameter and larger is of a minimum thickness of three-sixteenths of an inch and varies in thickness, based upon a safe working head under which the pipe is to operate. However, a very important point in reference to this thickness of pipe is the condition of the soil in which it will be laid; that is, the Department does not adhere to the minimum thickness, based on a safe working head, providing soil conditions are not favorable.

All of the riveted steel pipe up to forty inches in diameter is dipped in a bath of asphaltum, maintained at the highest possible temperature without burning, in order that there may be a thick and tough coating applied to the pipe. The pipe is left in this bath until the metal reaches the same temperature as the bath, insuring even coating.

Another factor that is very favorable in the use of riveted steel pipe in this locality is the fact that the waters in this vicinity are alkaline and do not attack the coating.

Pipe in this latter class is of lap-joint construction. This is also true in still larger diameter pipe. Pipe of sixty inches and greater diameter is coated with water gas tar, applied hot, both on the interior and exterior surfaces, two coats being generally used.

The pipe is delivered in the field in approximately 24-foot lengths, usually

Installation of Western Pipe & Steel 36" riveted steel main by the City of Los Angeles along Lankershim Boulevard.

being fabricated out of four 6-foot plates to the one tank section. These sections are riveted together in the field in approximately 100-foot lengths and lowered into the trench, where the one trench joint is made in each case. This practice was generally followed in the installation of all the large lines up to the present year. The Department has just recently completed the installation of a new 36-inch trunk line, eight miles in length, leading into the Hollywood Reservoir, and the method used in this case was different from that used in previous cases in the trench joint. As a matter of fact ten 4-plate sections were riveted together over the trench, making approximately a 230-foot section. This section was then lowered into the trench and the trench joint welded by means of the acetylene torch. The evolution in the installation of riveted steel pipe has been rather marked in the last few years by the use of pneumatic tools, acetylene torches, and welding. The average speed attained in the installation of this line was approximately 700 feet per day, while the maximum speed reached was 1000 feet per day. The pipe in all cases is buried a standard depth, being 30 inches from the top of the pipe to the finished grade of the street.

A very important feature in the operation of trunk lines constructed of steel is that of repairs in case of leaks. A steel pipe operating under a high head will give warning by damp spots or small pools of water accumulating along its course, so it is a fairly easy matter to uncover this pipe and install patches or caulk the metal if the trouble is in the seams. In other words, no great damage ever occurs from leaks or breaks in steel pipe, whereas in cast iron trunk lines of large diameter operating under a high head, whenever they do give way, there is usually a rupture that will release the entire capacity of the line with very destructive effect resulting in inconvenience to traffic and heavy damage to property and street improvements.

In a fast growing community such as Los Angeles, it has been very necessary within the past few years to change the grades of various trunk lines to conform to new street grades. In many instances we have had to lower trunk lines varying in diameter from 24 to 40 inches, several feet. This work has always been accomplished without interruption to the service; for example, we have lowered quite recently 1500 feet of forty-inch by five-sixteenths-inch line, a distance of from three to six feet. This was accomplished without turning off the water and not a single rivet was sheared nor a leak developed throughout the entire distance of 1500 feet. This particular phase in the use of riveted steel pipe conclusively emphasizes the economic value to be obtained under these circumstances.

The records obtained in exposing the various steel lines in our system, for making new connections and taps, are evidence that steel is a proper conduit for water lines. This is particularly true where soil conditions are good, and in fact, lines that have been in the ground more than thirty years under favorable soil conditions show that the original dip, both on the inside and the outside, is still intact and in good condition.

It has been our experience that the gate valve installed on a riveted steel line should be of the hub-end type, rather than of the flanged, as any undue strain that may be exerted at this joint with a hub-end valve would cause no damage, whereas in the case of a flanged valve, the flange would be sheared off and there would be the same result as is caused by the breaking of pipes of other material.

On the Los Angeles Aqueduct, there are twelve miles of siphons, varying in diameter from seven feet six inches to twelve feet. The thickness of metal varies from one-quarter inch to one and one-eighth inches. These pipes are all laid in the open, either being trenched on the hillside on the original ground surface, or carried on piers so that in all cases they are easily maintained by being accessible to painting and repairing.

By far the most formidable piece of riveted steel pipe construction in the world is that of the Jawbone Siphon on

the Los Angeles Aqueduct, this pipe being compound in its diameter, and varying from ten feet at both the intake and the outlet ends to seven feet six inches across the bottom. Lap-joint construction is followed up to one-half inch metal and butt-strap construction throughout the balance. The siphon operates under 860 feet of head. It has been in service for 16 years, is devoid of leaks, and there is absolutely no evidence of deterioration.

The accompanying table shows the amount of pipe in the total system, together with the segregation of steel pipe in the various districts, as well as the percentage of steel pipe in relation to the total distributing system.

Riveted Steel Mains in System June 30, 1914:	
10″ to 24″ diameter inclusive	15.0 miles
30″ to 42″ diameter inclusive	19.0 miles
Riveted Steel Mains Laid from June 30, 1914, to June 30, 1920:	
10″ to 27″ diameter inclusive	8.3 miles
30″ to 40″ diameter inclusive	13.6 miles
Riveted Steel Mains in San Fernando Valley System June 30, 1920:	
6″ to 27″ diameter inclusive	239.2 miles
30″ to 72″ diameter inclusive	39.4 miles
Riveted Steel Mains Laid in All Districts from June 30, 1920, to December 31, 1924:	
6″ to 8″ diameter	10.1 miles
10″ to 27″ diameter inclusive	26.0 miles
30″ to 36″ diameter inclusive	24.2 miles
	394.8 miles
Up to 27″ diameter	298.6 miles
30″ to 72″ diameter	96.2 miles
Total mileage in system December 31, 1924	2420.6 miles
Percentage of total mileage riveted steel	16 27/100%

A long section of W. P. & S. riveted steel pipe after lowering into trench. Mr. Mulholland's article discusses such work in detail.

William Mulholland, Man and Engineer

By W. W. Hurlbut

Office Engineer, Bureau of Water Works and Supply

SINCE time immemorial every profession, every line of human pursuit, has had its outstanding character, its shining light, its great leader. In the profession of water works engineering there is an outstanding figure, a leader who in the annals of the City of Los Angeles has proven to be a builder of an empire—an empire of unsurpassed progress in municipal development—William Mulholland.

Without a doubt he is a leader, and an uncommon leader, in that it is his common sense, together with his unusual foresight and sound judgment, which awakened the embryo City of Los Angeles to its boundless opportunities and firmly set the city on its road to progress.

He is, as well, an outstanding figure in the engineering world in that it was his untiring aggressiveness that made this unusual foresight, this sound judgment, of commercial value and a source of future prosperity to the people of Los Angeles. His personal traits explain his remarkable success, both along engineering lines and in his associations with his fellow workmen and the public at large.

The inherent modesty of Mr. Mulholland, as I know him, precludes an inventory of his merits, his personal ambitions, and his simple faith that the public will understand and approve those ambitions. Modesty, honesty, frankness and astuteness are not uncommon attributes, but they are more highly developed in some men than in others. The writer, from a long and intimate friendship and association with Mr. Mulholland, has observed that he possesses all these qualities to a degree seldom found in any one individual, and more seldom used judiciously and for the public weal. To these traits is added a fund of courage that makes his modesty entirely natural, his honesty and frankness a matter of course, and his astuteness a source of good fellowship and pride to his fellow workmen.

Perhaps the two characteristics which contribute most to his success as a professional man are his keen sense of observation and his highly developed technical memory. There is no characteristic more highly necessary to the successful engineer or professional man than a highly developed sense of observation, tempered with common sense, and retained by a good memory. These Mr. Mulholland possesses to a marked and an unusual degree.

That the public at large realizes his possession of these qualifications of the successful engineer, is shown in their approbation of his untiring efforts in providing the city with the most essential element of its growth—nay, its very life blood.

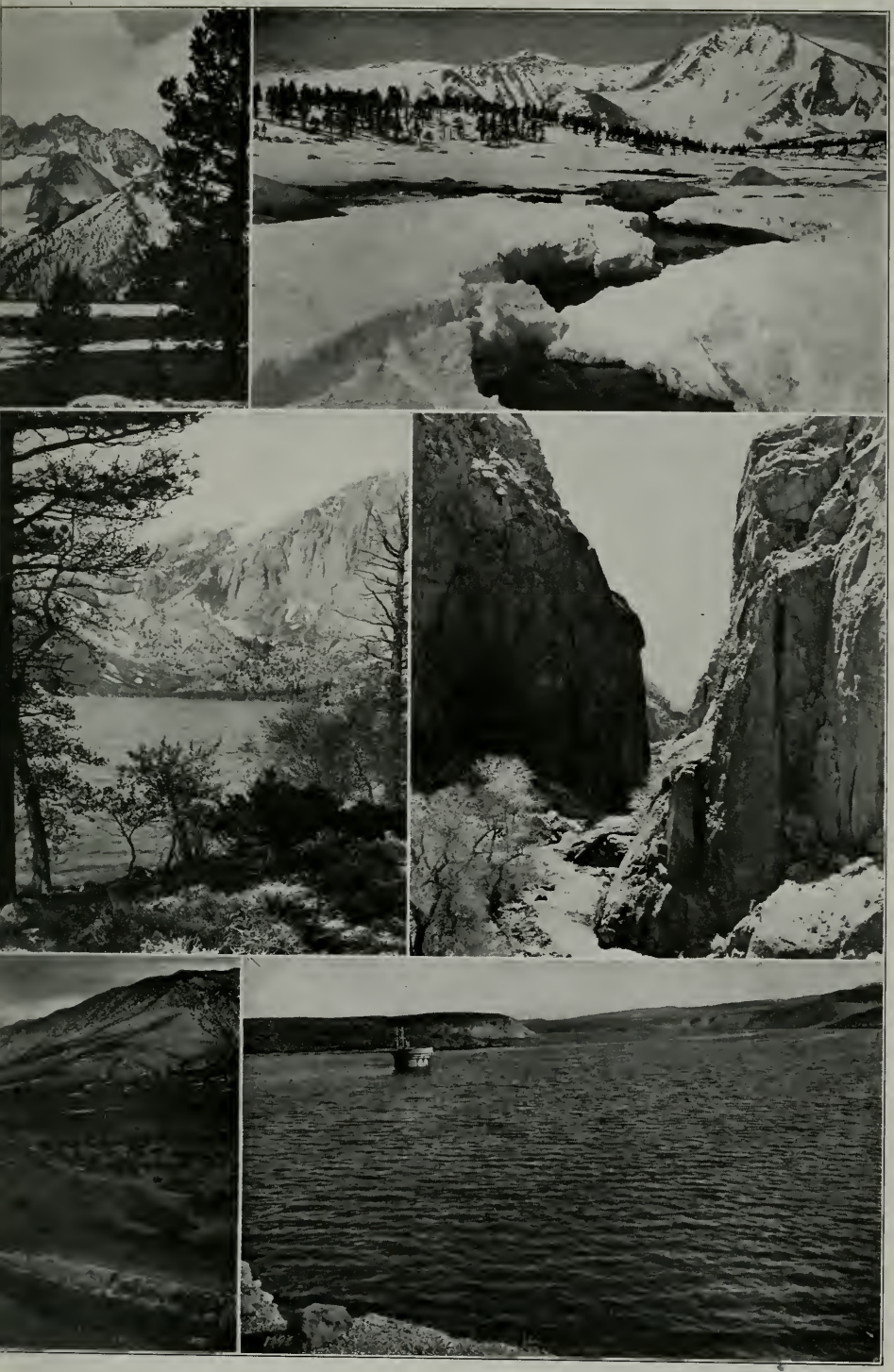
In the annals of water works construction no other one man has the unique distinction of having completely built a distributing system, as well as the water supply to provide a city throughout its growth from a mere hamlet of nine thousand people to a metropolis of a million and a quarter, within the short space of 46 years.

The engineer, as well as the man, is judged by his achievements—the only form of judgment allowed man on this earth. The achievements of Mr. Mulholland are world-famous, daring, unusual, and the key-note to the development of one of the world's greatest potential commercial and agricultural centers.

His bequest to posterity embraces the greatest collection of individual engineering feats in water work construction ever developed by any one man, among them the construction of twenty-seven dams and as many reservoirs, and the construction of the longest aqueduct in the world —a 238-mile span of mountain and desert.

Yet these are only forerunners to the great achievements necessary in the very near future.

FROM THIS PICTURESQUE COUNTRY IN THE HIGH SIERRAS LOS ANG
the Owens River. 2—Palisade Glacier in May. Melting snow and ice on these slopes f
summit crags of Mt. Whitney, the highest elevation in continental United States, 14,501
beautiful lakes in the high mountains that contribute water to Los Angeles. 4—Gorge o
Aqueduct. 2—Typical scene along the Los Angeles Aqueduct which, in this high countr



ES ITS UNSURPASSED WATER SUPPLY—*Upper row (left to right)* 1—*Source of* 3—*A June scene in the Cottonwood Lake Basin. Center row (left to right)* 1—*The Lakes, the waters of which flow into Owens River.* 3—*Convict Lake, one of the* 82 *River. Lower row (left to right)* 1—*View of Owens River above the intake of the canal.* 3—*Haiwee Reservoir.*

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EDITED BY EDWARD F. O'DAY

A READING of the character study of William Mulholland in this issue of *Western Pipe and Steel News* cannot fail to enforce the conviction that here is a most unusual man. The name of William Mulholland will be written high and large on the scroll of great Western Americans. But his monument—the only monument he needs—is the water supply of Los Angeles.

For more than thirty-seven years, ever since its establishment, this Company has been identified with the development of the Los Angeles water supply. The fact that William Mulholland shares our conviction as to the superiority of riveted steel pipe for water works long since created a bond of sympathy between us, so that our business relations with the Los Angeles Bureau of Water Works and Supply have been maintained on a level of mutual understanding and pleasant co-operation.

The opportunity for contact with the great engineers of the West is one of the delightful privileges of our business. The men who do the big things in water works, oil, hydroelectric development, irrigation, railway and highway building—these men see keenly and see far. They go forward with long strides. They measure time, not by years or decades, but by generations. To keep pace with such men calls for the best efforts of an organization. William Mulholland, among others, seems to believe that we have passed the test.

The two greatest water projects ever initiated in California are the Owens River supply for Los Angeles and the Hetch Hetchy supply for San Francisco. In both, the pipelines are of riveted steel. The reasons for this are set forth admirably in the article which William Mulholland wrote specially for this issue. There is nothing we can add to his statement of the case. He has said it all, and he speaks with authority, with finality.

More than 16 per cent of the distributing system of Los Angeles is riveted steel pipe. This is another W. P. & S. line.

The Los Angeles Aqueduct

FROM the founding of the pueblo in 1781, when the population was 44, up to 1914, when the city had passed the half million mark, the entire water supply of Los Angeles came from the Los Angeles River. To quote William Mulholland: "The existence of this seemingly insignificant stream afforded the sole original excuse for Los Angeles, for without it the pueblo would never have been founded by the early Padres, nor the region settled by the aborigines who preceded them."

This supply, augmented by ground water development, served well enough until the city began to get into its growth stride, but in the decade 1890-1900 the population increased more than 100%. Furthermore, there began in the winter of 1893-94 one of those dry cycles common to semi-arid regions, which lasted until 1904. Those were anxious times.

"We repeatedly faced a water famine," said Mulholland. "There were times in the summer of 1900 and 1901 and up to 1904 when there was scarcely a day's supply left in the reservoirs. During this eleven-year dry period the annual rainfall averaged but 11¼ inches. The Los Angeles River shrank from its average yield of about 52,000,000 gallons daily to less than 28,000,000. In consequence of this long continued drouth, early in 1904 the question of a greater water supply came prominently to the front, and as a result the Owens River was finally selected as the most feasible of all the proposed schemes."

Construction on the Aqueduct began October 1, 1908, although much preparatory work had been launched the year before. The project was completed and

Soledad Syphon, Los Angeles Aqueduct. Soledad and Jawbone Syphons were not fabricated by W. P. & S. They are shown here to illustrate the use of riveted steel pipe.

water came through the Aqueduct from Owens Valley to San Fernando November 5, 1913. The undertaking was completed within both time and cost limits originally set by Mulholland. There was a great celebration the day the water came through, and not only was water history made, but oratorical history as well, for when the grizzled engineer who accomplished this titanic feat was called upon to make a speech presenting the water to the people of Los Angeles, with a sweep of his arm he pointed to the foaming stream tumbling down the incline and said: "There it is, take it!"

The Owens River has its source in the High Sierras approximately east of Yosemite Valley and almost due east of San Francisco.

Thus the stream draws from the highest mountains in the United States, among them Mt. Whitney, 14,501 feet. There are 82 lakes in the High Sierras contributing to the water flow for the Los Angeles Aqueduct, situated at altitudes varying from 6000 to 12,000 feet.

The point of diversion from the Owens River to the Aqueduct is twelve miles above Independence, at an elevation of 3714 feet, and 238 miles from Los Angeles. From the Intake to the Alabama Hills the aqueduct is an open, unlined ditch passing through a water-soaked land. From the Alabama Hills to Haiwee Reservoir it is a concrete-lined canal.

Below Haiwee Reservoir the Aqueduct is covered for its entire length. It first crosses Rose Valley and then winds along the eastern slope of the Sierras, passing through some of the mountains by tunnels and crossing the canyons by means of syphons. Jawbone Canyon is crossed by means of a steel syphon which varies in size from 10½ feet to 7½ feet diameter, and at its lowest point in the canyon is 850 feet below the high end.* From Jawbone the line follows the hills at the north rim of the Mojave Desert and Antelope Valley. Across the latter there is another steel syphon 4½ miles in length. From Antelope Valley the line swings east to Fairmont Reservoir; by tunnel under Elizabeth Lake to San Francisquito Canyon; thence through mountain tunnels into Dry Canyon Reservoir, whence, by tunnels and syphons, the water travels to the north side of San Fernando Valley and so arrives at the San Fernando Reservoirs. Here the water is at the city's gates, and goes into the vast distribution system that embraces nearly 2500 miles of pipe.

After a check of sixteen years' measurements and gaugings on the Owens River, Mulholland placed the average available yield from the Aqueduct in excess of 400 second feet, equal to 258,000,000 gallons daily. This, plus the local sources which Mulholland has always kept developed to the limit, makes an aggregate available supply for the city of 326,000,000 gallons daily, which, based on average per capita consumption, indicates that Mulholland has developed a water system that today could meet the needs of a population of 3,250,000.

Jawbone Syphon, Los Angeles Aqueduct.

* W. P. & S. is fully equipped to do heavy work similar to the huge syphons on the L. A. Aqueduct; it has fabricated and installed some of the biggest syphons in the West.

The Maker of Los Angeles

By Richard Prosser

WHEN William Mulholland was a boy in Ireland—he was born at Belfast in 1855—he was possessed of such intense longing for the sea that he finally ran away and joined a ship, taking an older brother with him to see the world. After forty-seven years of life ashore, during all of which time he has been identified with the always pressing problem of supplying water for what he calls the "galloping city of Los Angeles," he still loves the sea. The sight of a tall windjammer yet stirs his blood and mention of the old days moves him to reminiscence.

All told he spent more than four years before the mast, including a season on the Great Lakes. While sailing deep water he crossed the Atlantic nineteen times. When he was twenty-one he and his brother found themselves in Acapulco, whence they shipped in a sailing vessel bound for San Francisco. There they decided to see the wonders of California, and to visit some relatives who had come from Ireland years before. This was in 1877 and William Mulholland has been here ever since. Here is his story:

"After seeing San Francisco, we began to travel about, and presently found ourselves at Martinez. After some debate as to how we should get to Los Angeles, where our relatives were, we finally bought two old plugs and rode down through the San Joaquin Valley, over the mountains and into the South. After about a month I had enough of life ashore, so I started for San Pedro to find a ship. On the way down a man whose business was boring wells offered me a job, and, although I longed to get back to sea, I decided to take it.

"The first well I worked on changed the whole course of my life. When we were down about six hundred feet we struck a tree. A little further we got some fossil remains, and these things fired my curiosity. I wanted to know how they got there, so I got hold of Joseph Le Conte's book on the geology of this country.

"Right there I decided to become an engineer. Before the year was out I had made a study of the terrain around Los Angeles, living in a shack in the river bottoms; had made a trip over to the Colorado river, going up by boat to Ehrenberg, then an important Arizona town; and had decided to stay in Southern California and grow up with the country. I built a water-wheel on the Colorado to lift water for a truck garden.

"Afterwards, around Los Angeles, I bored wells, built dams, and worked at other things, all connected with water. I worked as a ditch tender, and that was really the beginning of my career with the City of Los Angeles. Last summer one of my engineers was making a special survey of the coastal plain between Los Angeles and the harbor, and at Dominguez Field he found an old windmill humming away, pumping water from an eight-inch well that I bored in 1877.

"In the early days, the city did not own its water works, but was supplied by the Los Angeles City Water Company, and of this company I became Chief Engineer and Superintendent in 1886. In 1898 the company's franchise expired, but because of litigation the city did not come into possession until 1902. The city took me over with the works.

"So I have had an experience that no man has had before me, of keeping up the water supply for a galloping community such as Los Angeles has been, from a town of a few thousand souls to a roaring metropolis of 1,200,000, which is my

estimate of our population at present."

William Mulholland, like many another brilliant Irishman, has a natural bent for mathematics. By the time he was a lad of fourteen he had mastered higher mathematics and the science of navigation. The captains and mates of the ships he sailed in were not long in discovering this, with the result that he usually had the job of working out the ship's position. He could get it at noon by the sun if the sun was in sight, or at night by the stars, and he became an expert in dead-reckoning in the fogs off the Newfoundland Banks. But he does not believe a mathematical mind necessarily indicates any mental capacity beyond figures. On the contrary.

"A mathematical mind does not indicate a fine mind, in any way," he says. "It is a trait—or gift—that a few people are born with. A mathematician cannot be made. If he wasn't born with the knack you can't drive it into him. But I have known a lot of gifted mathematicians in my time who were absolutely worthless at anything else. So I don't know but what it may be a drawback. Music is the same. Sometimes a driveling idiot can appreciate and be charmed by music, which is another natural gift.

"The trouble with a great many men who are brilliant at mathematics is that they don't or can't broaden mentally in other directions. Take engineers, for example. I know very few engineers that read books outside of the technical stuff of their profession, and consequently their views are not broad and their outlook on life is restricted. They come in contact with but few people, so their knowledge of human nature is limited.

"Damn a man who doesn't read books.

"The test of a man's mind is his knowledge of humanity, of the politics of human life, his comprehension of the things that move men.

"Alexander Pope said: 'The proper study of mankind is Man.'

"I believe in that thoroughly, and I believe that with our limited personal contacts with men who do things, who know things, and who are leaders in thought and achievement, the only feasible way to study mankind is by reading good books, written by men who were masters of their art. Besides, you must remember that there are more great men dead than there are living, and the only way to find out what they knew is through reading.

"All my life I have read good books. I am an inveterate reader of Shakespeare. Hamlet is my favorite. That play contains more fine aphorisms and wise precepts than any other work I know of. I like Thomas Carlyle. No man can say that he understands human nature, the actions and reactions of men, unless he has read Carlyle's History of the French Revolution. There have been great writers in every age. In our own time we have had Mark Twain and Ambrose Bierce, both remarkable men, men who knew life, and human nature, and how to write about it. I am reading Mark Twain's Autobiography now."

William Mulholland, hydraulic engineer and scholar, is also a learned botanist. But he is more than all this—he is the Maker of Los Angeles.

THE COVER PICTURE—*We present on the cover a picture of William Mulholland and the newest of the twenty-seven dams he has built for Los Angeles. This is called Mulholland Dam in honor of the builder. It closes Weid Canyon and forms the new Hollywood Reservoir (elevation 750). The dam impounds 8000 acre feet of water. The reservoir is supplied from the Los Angeles Aqueduct by a 36" riveted steel trunk line, fabricated in part by Western Pipe & Steel. The dam is 180' high, 160' through the maximum section at the bottom, and 16' wide at the top with a 4' overhang on each side. It is 900' along the top, and the roadway connects with the new Mulholland Highway. Mulholland said of this dam: "It is the first thing I have ever designed with an eye to ornamental effect. My work has always been severely plain and practical, but here I felt that beauty might well go hand in hand with usefulness." How well he succeeded in creating a structure of enduring beauty may be judged from the picture.*

LOS ANGELES HAS NEARLY 400 MILES OF RIVETED STEEL MAINS IN ITS DISTRIBUTING SYSTEM—*The picture shows a 36" line which follows the west bank of the Los Angeles River, fabricated by Western Pipe & Steel. This is in the heart of the city.*

WESTERN PIPE AND STEEL NEWS

GOOD CULVERTS HELP MAKE GOOD ROADS—*Upper left—Skyline Boulevard south of San Francisco, drained by W. P. & S. culverts. Upper right—W. P. & S. culverts under a road built by San Joaquin Light & Power Co. Lower—Section of Pacific Highway in Sacramento River Canyon north of Redding. Picture shows how Highway Commission is straightening curves and widening grades.*

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PROCEEDINGS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS
PHILADELPHIA, PENNSYLVANIA
Volume 23, Part 1, 1923

TABLE II.—FAILURES AT PITTSBURGH TESTS. INSPECTIONS OF 1917, 1918, 1919, 1920, 1921, 1922 AND MARCH, 1923. SHEETS EXPOSED DECEMBER 12, 1916. COMPARING COPPER-BEARING WITH NON-COPPER-BEARING MATERIALS.[1]

Group	Designation.	Series.	Description.	Average Analysis. Carbon.	Manganese.	Phosphorus.	Sulfur.	Silicon.	Copper.	Number of Sheets in Test.	Date of Inspection. Oct. 9, 1917. 10 Months.	April 9, 1918. 10 Months.	Oct. 7, 1918. 22 Months.	April 1, 1919. 28 Months.	Nov. 6, 1919. 33 Months.	May 11, 1920. 41 Months.	Oct. 12, 1920. 46 Months.	April 5, 1921. 52 Months.	Oct. 18, 1921. 58 Months.	April 11, 1922. 64 Months.	Oct. 17, 1922. 70 Months.	May 9, 1923. 75 Months.	Number of Sheets Failed in Test.
	No. 16 Gage Sheets.																						
EE	Puddled Iron	A	Copper-Bearing	0.035	0.03	0.110	0.018	0.125	0.319	12	None	None	None	None	None	None	None	None	None	None	None	None	None
HH	Copper-Bearing Basic Open-hearth Steel	A	" "	0.074	0.373	0.011	0.020	0.034	0.227	15	None	None	None	None	None	None	None	None	None	None	None	None	None
II	Copper-Bearing Bessemer Steel	A	" "	0.093	0.271	0.025	0.003	0.005	0.247	16	None	None	None	None	None	None	None	None	None	None	None	None	None
KK	Copper-Bearing Acid Open-hearth Steel	A	" "	0.106	0.433	0.085	0.043	0.005	0.234	19	None	None	None	None	None	None	None	None	None	None	None	None	None
COO	Copper-Bearing Pure Iron	A	" "	0.025	0.029	0.006	0.038	0.005	0.229	12	None	None	None	None	None	None	None	None	None	None	None	None	None
TT	Copper-Bearing Steel, Newport Rolling Mill Co.	B	" "	0.060	0.313	0.006	0.020	0.005	0.223	14	None	None	None	None	None	None	None	None	None	None	None	None	None
UU	Copper-Bearing Pure Iron, Allegheny Steel Co.	B	" "	0.018	0.058	0.008	0.036	0.005	0.229	14	None	None	None	None	None	None	None	None	None	None	None	None	None
VV	Copper-Bearing Pure Iron, Whitaker-Glessner Co.	B	" "	0.018	0.048	0.007	0.018	0.004	0.229	13	None	None	None	None	None	None	None	None	None	None	None	None	None
ZZ	Copper-Bearing Bessemer Steel, Youngstown Sheet and Tube Co.	B	" "	0.08	0.40	0.092	0.031	0.004	0.153	1	None	None	None	None	None	None	None	None	None	None	None	None	None
ZZ	Copper-Bearing Bessemer Steel, Youngstown Sheet and Tube Co.	B	" "	0.06	0.31	0.098	0.017	.....	0.271	3	None	None	None	None	None	None	None	None	None	None	None	None	None
ZZ	Copper-Bearing Bessemer Steel, Youngstown Sheet and Tube Co.	B	" "	0.07	0.35	0.095	0.033	.....	0.249	3	None	None	None	None	None	None	None	None	None	None	None	None	None
ZZ	Copper-Bearing Open-hearth Steel, Youngstown Sheet and Tube Co.	S	" "	0.05	0.37	0.054	0.064	.....	0.233	3	None	None	None	None	None	None	None	None	None	None	None	None	None
ZZ	Copper-Bearing Open-hearth Steel, Youngstown Sheet and Tube Co.	S	" "	0.09	0.33	0.032	0.056	0.003	0.375	3	None	None	None	None	None	None	None	None	None	None	None	None	None
ZZ	Copper-Bearing Open-hearth Steel, Youngstown Sheet and Tube Co.	S	" "	0.07	0.40	0.035	0.048	.....	0.364	2	None	None	None	None	None	None	None	None	None	None	None	None	None
	Total									132	None	None	None	None	None	None	None	None	None	None	None	None	None
AA	Bessemer Steel	A	Non-Copper-Bearing	0.043	0.419	0.083	0.042	0.004	0.012	17	None	None	None	25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36 (12)	21, 22, 23, 24 (4)	....	....	....	....	....	....	....	17 (All)
BB	Open-hearth Steel	A	" " "	0.056	0.349	0.072	0.048	0.037	0.113	17	None	None	None	None	None	None	None	None	23 (1)	20, 21 (2)	24 (1)	None	4
CC	Copper-Bearing Pure Iron	A	" " "	0.019	0.029	0.004	0.042	0.013	0.067	17	None	None	None	None	None	None	None	None	18 (1)	15, 17 (2)	16, 31, 33 (3)	None	6
DD	Low-Copper Pure Iron	A	" " "	0.019	0.028	0.004	0.027	0.004	0.028	18	None	None	None	None	None	None	None	None	33, 36 (2)	27, 28, 29, 30, 31, 32, 35, 37, 38 (9)	4, 5, 9, 49 (3)	47, 48 (2)	16 (1)	17
DO	Low-Copper Open-hearth Steel	A	" " "	0.103	0.371	0.009	0.029	0.007	0.029	12	None	None	None	None	None	None	27 (1)	25, 26, 28, 33 (4)	29, 30, 31, 34, 35, 36 (5)	32 (1)	....	....	12 (All)
MM	Open-hearth Steel, Alex Wood Iron and Steel Co.	S	" " "	0.017	0.414	0.010	0.029	0.007	0.057	16	None	None	None	None	None	None	None	None	29, 30, 35, 38, 40 (5)	41 (1)	31, 32, 37, 39, 42 (5)	None	11
SS	Low-Copper Pure Iron, American Rolling Mill Co.	S	" " "	0.017	0.021	0.005	0.021	0.005	0.005	14	None	None	None	None	None	29, 30, 31, 32, 33, 35, 36 (7)	34, 36, 37, 38, 41 (5)	42 (1)	....	....	....	....	14 (All)
XX	Low-Copper Pure Iron, Inland Steel Co.	S	" " "	0.021	0.062	0.008	0.030	0.005	0.018	14	None	None	None	None	None	29, 30, 31, 32, 33, 35 (6)	34, 36, 37, 38, 39, 40 (6)	41 (1)	36 (1)	33, 34, 35, 38, 39, 40 (6)	7, 42 (2)	....	....	14 (All)
YY	Low-Copper Wrought Iron, Youngstown Sheet and Tube Co.	S	" " "	0.03	0.051	0.123	0.019	0.203	0.013	3	None	None	None	None	None	None	None	None	None	7, 8 (2)	8 (1)	....	3 (All)
ZZ	Bessemer Steel, Youngstown Sheet and Tube Co.	B	" " "	0.07	0.35	0.097	0.017	0.008	0.013	3	None	None	None	None	8, 10, 14 (3)	None	None	None	None	None	None	None	3 (All)
ZZ	Open-hearth Steel, Youngstown Sheet and Tube Co.	B	" " "	0.032	0.40	0.016	0.078	.....	0.038	2	None	None	None	None	None	None	None	None	None	None	None	None	3
	Total									126	None	None	None	13	7	13	8	14	25	8	23	1	102
	No. 22 Gage Sheets.																						
SS	Open-hearth Steel	A	Copper-Bearing	0.08	0.27	0.014	0.053	0.005	0.179	9	None	None	None	None	17 (1)	18 (1)	31, 32 (2)	22, 34, 39 (3)	19, 20 (2)	....	....	....	9 (All)
GG	Copper-Bearing Pure Iron	A	" " "	0.015	0.038	0.005	0.036	0.003	0.199	9	None	None	None	None	11, 12, 14, 22 (4)	32, 34, 35 (3)	33 (1)	12 (1)	....	....	....	....	9 (All)
EE	Puddled Iron	A	" " "	0.023	0.034	0.116	0.021	0.134	0.283	12	None	None	24, 36 (2)	29, 30, 31, 33 (4)	25, 27, 34, 35 (4)	26, 28 (2)	....	....	....	....	....	....	17 (All)
U	Copper-Bearing Basic Open-hearth Steel	A	" " "	0.069	0.387	0.015	0.027	0.004	0.344	12	None	None	None	None	None	None	None	38, 40, 42, 45, 49 (5)	47 (1)	43 (1)	41 (1)	....	12 (All)
I	Copper-Bearing Bessemer Steel	A	" " "	0.041	0.385	0.097	0.068	0.008	0.252	18	None	None	None	None	None	None	None	50, 52, 54, 55 (4)	None	None	None	None	None
K	Copper-Bearing Acid Open-hearth Steel	A	" " "	0.107	0.447	0.091	0.046	0.004	0.237	16	None	None	None	None	None	None	None	None	35, 41 (2)	37, 39 (2)	34, 42, 43, 45, 46, 48 (7)	None	11
M	Open-hearth Steel, Alex Wood Iron and Steel Co.	B	" " "	0.093	0.419	0.013	0.041	0.011	0.185	16	None	None	None	None	None	32, 38, 42 (3)	39, 41 (2)	29, 30, 33, 34, 35, 37, 38, 40 (8)	31 (1)	....	....	....	14 (All)
T	Copper-Bearing Steel, Newport Rolling Mill Co.	B	" " "	0.063	0.313	0.009	0.020	0.005	0.227	14	None	None	None	None	37, 39 (2)	32, 33, 35 (3)	29, 30, 31, 34, 40, 42 (6)	29 (1)	....	....	....	....	14 (All)
U	Copper-Bearing Pure Iron, Allegheny Steel Co.	B	" " "	0.017	0.074	0.008	0.037	0.005	0.250	14	None	None	None	None	41 (1)	29, 30, 40 (3)	31, 32, 34, 35, 38 (5)	37, 39, 37 (3)	....	....	....	....	14 (All)
V	Copper-Bearing Pure Iron, Whitaker-Glessner Co.	B	" " "	0.018	0.051	0.007	0.021	0.005	0.304	14	None	None	None	None	29, 39 (2)	36, 37, 42 (3)	30, 32, 34, 35, 38, 40, 41 (7)	31, 32 (2)	....	....	....	....	14 (All)
Z	Copper-Bearing Bessemer Steel, Youngstown Sheet and Tube Co.	B	" " "	0.039	0.37	0.094	0.038	0.007	0.257	2	None	None	None	None	None	None	None	None	None	214 (1)	209, 213 (2)	....	3 (All)
Z	Copper-Bearing Open-hearth Steel, Youngstown Sheet and Tube Co.	S	" " "	0.043	0.37	0.100	0.049	.....	0.533	2	None	None	None	None	None	None	None	None	None	310, 314 (2)	....	....	3 (All)
Z	Copper-Bearing Open-hearth Steel, Youngstown Sheet and Tube Co.	S	" " "	0.06	0.35	0.049	0.020	.....	0.212	3	None	None	None	None	None	None	None	502, 513, 515 (3)	....	....	....	....	3 (All)
Z	Copper-Bearing Open-hearth Steel, Youngstown Sheet and Tube Co.	S	" " "	0.07	0.39	0.039	0.038	.....	0.295	3	None	None	None	None	None	None	None	597, 605, 609 (3)	....	....	....	....	3 (All)
Z	Copper-Bearing Open-hearth Steel, Youngstown Sheet and Tube Co.	S	" " "	0.07	0.41	0.050	0.030	.....	0.621	3	None	None	None	None	None	None	None	None	None	714 (1)	None	712 (1)	3 (All)
	Total									146	None	None	2	4	14	20	25	28	12	5	12	1	123
A	Bessemer Steel	A	Non-Copper-Bearing	0.038	0.385	0.059	0.010	0.007	0.014	17	None	None	31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47 (15)	29 (1)	....	....	....	....	....	....	....	....	17 (All)
BB	Open-hearth Steel	A	" " "	0.09	0.38	0.017	0.052	0.036	0.082	4	None	None	None	None	....	....	....	....	....	....	....	....	4 (All)
CC	Copper-Bearing Pure Iron	A	" " "	0.01	0.028	0.002	0.027	0.022	0.139	2	None	None	None	None	37 (1)	28 (1)	35 (1)	36 (1)	....	....	....	....	2 (All)
DD	Low-Copper Pure Iron	A	" " "	0.02	0.026	0.004	0.022	0.002	0.024	2	None	None	None	None	20 (1)	21 (1)	....	....	....	....	....	....	2 (All)
DO	Low-Copper Open-hearth Steel	A	" " "	0.121	0.546	0.008	0.030	0.249	0.020	12	None	None	30, 35, 38 (3)	31, 33, 34, 36, 39, 40 (6)	....	....	....	....	....	....	....	....	9 (All)
SS	Low-Copper Pure Iron, American Rolling Mill Co.	B	" " "	0.02	0.023	0.006	0.023	0.004	0.022	14	None	None	25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36 (12)	....	....	....	....	....	....	....	....	....	12 (All)
XX	Low-Copper Pure Iron, Inland Steel Co.	B	" " "	0.021	0.035	0.007	0.031	0.004	0.027	14	None	None	29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42 (13)	....	....	....	....	....	....	....	....	....	14 (All)
YY	Low-Copper Wrought Iron, Youngstown Sheet and Tube Co.	B	" " "	0.03	0.055	0.130	0.021	0.218	0.020	3	None	None	29, 40, 44, 47 (4)	....	....	....	....	....	....	....	....	....	3 (All)
ZZ	Bessemer Steel, Youngstown Sheet and Tube Co.	B	" " "	0.055	0.37	0.110	0.045	0.003	0.013	3	None	None	None	7, 8, 9 (3)[2]	....	....	....	....	....	....	....	....	3 (All)
ZZ	Open-hearth Steel, Youngstown Sheet and Tube Co.	S	" " "	0.07	0.40	0.083	0.018	0.005	0.133	2	None	None	11 (1)	6, 7 (2)	....	....	....	....	....	....	....	....	3 (All)
ZZ	Open-hearth Steel, Youngstown Sheet and Tube Co.	S	" " "	0.10	0.32	0.069	0.044	0.002	0.019	3	None	None	None	None	None	None	None	113 (1)	None	None	111, 112 (2)	....	3 (All)
	Total									84	None	None	30	37	10	2	2	None	1	None	None	2	84 (All)

[1] In preparing this table, sheets below 0.15 per cent copper have been considered as non-copper-bearing, and those above 0.15 per cent as copper-bearing.
[2] These "Y" Sheets were reported as failures at the Nov. 5, 1918, inspection, but are placed in this column because they were exposed about six months later than all other sheets.

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California's Progress Toward a Perfect Highway System

By HARVEY M. TOY

Chairman, California Highway Commission

THE position of highway commissioner, while strenuous, is one of the most enjoyable through which a red-blooded American can render service to his country. The last two years, the period during which I have served as chairman of the California Highway Commission, have been among the happiest of my life. I have felt that I was engaged in a constructive work of benefit not only to the present but generations yet unborn. I have aided, in a humble way, in furthering a new system of transportation for America, the completion of which will usher in a new era of expansion and development, of progress and prosperity. The day has come in America when every man, woman and child is vitally affected by the progress of highway construction. The time has arrived, also, when the states must think not alone of their individual roads, but of merging their highways into a great national system, serving all parts of the country and binding us together in firmer bonds of understanding and friendship.

HARVEY M. TOY
Fisher Photo

Realization of this fact by leaders in the highway movement is responsible for the changing situation in California. We are forced to the conclusion that, while we must connect our great centers of population with paved highways, we must also push forward construction to the boundary lines of adjoining states. Construction and maintenance programs are under way on the main trunk lines through Southern California to connect with Arizona at Yuma, Blythe and Needles; on the Truckee River highway, for a connection with Nevada and the East; and on the Pacific and Redwood highways, from the San Francisco Bay district northward to the Oregon border. We have every reason to believe that this program has the hearty support of the people of the State.

Under the present commission and engineer higher standards of construction have been adopted. On main trunk lines, we are building no pavements less than twenty feet in width and six inches in thickness. We have adopted the Arizona plan of the thickened edge for our concrete roads and all pavement edges are now thickened to nine inches in three feet, a practice which is becoming standard throughout the country. We have built some roads twenty-four, forty and even fifty-six feet wide. The last was done in co-operation with Los Angeles County. Nothing less will handle the tremendous traffic of Southern California.

We are now a State of 1,300,000 motor vehicles. Predictions of a few years back have been so far exceeded that no one will hazard a guess at what the future total will be. The 1925 total is predicted at 1,500,000.

Our maintenance department is taking a traffic census throughout the State two days each month, and our engineers are watching traffic figures closely in planning new work and allotting maintenance funds. Grades on our mountain roads are being widened to thirty feet and straightened wherever possible.

The Peninsula Highway, south of San Francisco, has been widened to forty feet, and along the San Francisco Bay Shore we are beginning the construction of a great industrial highway on a right of way 125 feet wide, the traveled roadway eventually to be 100 feet wide.

Aside from widening and thickening of existing pavements, grading and location of mountain interstate connections are among our biggest problems. Centers of population in California have been connected with hard-surfaced pavements in past years. Traffic is now forcing us to widen these roads from fifteen to twenty feet, and in some cases to a greater width.

This may seem an ambitious program for a State whose road building funds are about exhausted, but I am confident the general approval given these higher standards of highway building will mean support for the future.

In conclusion, let me say again that I believe the people of California appreciate the added safety and traffic-carrying capacity of the highways which our higher construction standards provide. One of the most encouraging factors in the highway situation is the evidence that the people of the State are coming to an understanding of the fact that a great highway system cannot be created in a day; that it will take years of study, planning, and hard work to bring about its ultimate completion. And, most important of all, they are beginning to realize that the job cannot be done with spasmodic bond issues of a few million dollars; but, rather, that competent highway engineers must be given an annual construction fund, over a period of years, provided by some sound, well thought-out plan of financing.

By shortening curves and widening grades, the California Highway Commission is saving five miles in the sixty-mile stretch from Redding to Dunsmuir—Pacific Highway. Many W. P. & S. culverts were used under this road.

California's Highways, Present and Future

By Robert M. Morton
State Highway Engineer

HIGHWAY construction in California has proceeded at a faster rate during the last two and one half years than during any equal period since the State's highway project was launched by the bond issue of 1910. In the 24 months ending June 30, 1924, the Commission expended over $34,500,000 for primary construction, reconstruction and maintenance. These expenditures included bond funds, federal aid and the State's share of the motor vehicle fees. For the calendar year 1924 the expenditure from all sources, including the State's share of the motor vehicle fees and gasoline taxes, was $17,700,000.

R. M. MORTON

For this outlay of money, the people of California received during 1924, 646 miles of completed and accepted (original and reconstructed) highway. There were completed 519.9 miles of original construction, including 282 miles of graded and rock surface roads; 145 miles of rock surface (previously graded), 29 miles of cement concrete pavements, 10 miles of asphalt concrete pavements, and 52 miles of asphalt macadam. Under reconstruction we completed 87½ miles of various types of pavements and 39 miles of grades widened and straightened.

Although at the present time our bond funds are virtually exhausted and we are forced to get along on available Federal aid funds, it is hoped that future financing of highway construction will soon be placed on a sound and fixed basis so that we can plan the work ahead.

California's net highway mileage is now 6504 miles, but of this only 2085 miles have been paved by the State. Of the rest, 280 miles have been paved by counties and taken over; 83 miles of county paving have not been taken over; 1240 miles have been graded by the State; and 2814 miles, or 40 per cent of the system have had no construction.

Our great problem, then, is to finance the construction of some 3700 miles of highways to complete the system, and the minimum estimate for this work is $200,000,000 and 10 to 20 years.

To keep construction going at the rate we have attained in the last few years will require for primary construction alone $1,000,000 per month, and not less than $8,000,000 per year for maintenance and reconstruction. This latter sum is assured in income from vehicle and gas tax, funds which are restricted by law to expenditure for such work.

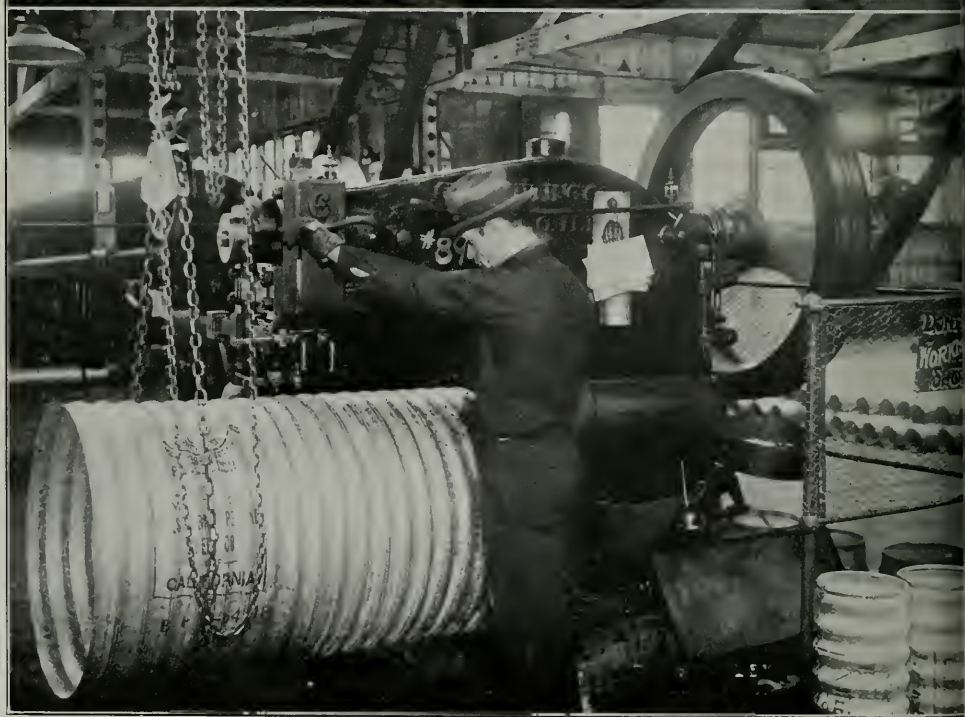
Thus California's requirements are $20,000,000 per year as a minimum, of which provision is yet to be made for $12,000,000 for primary construction.

Business men will, perhaps, have a better idea of the magnitude of the operations of their Highway Commission, if they have some figures to think over. For instance, our purchasing department spends over $2,000,000 per year for material and supplies. Some of the major items last year follow:

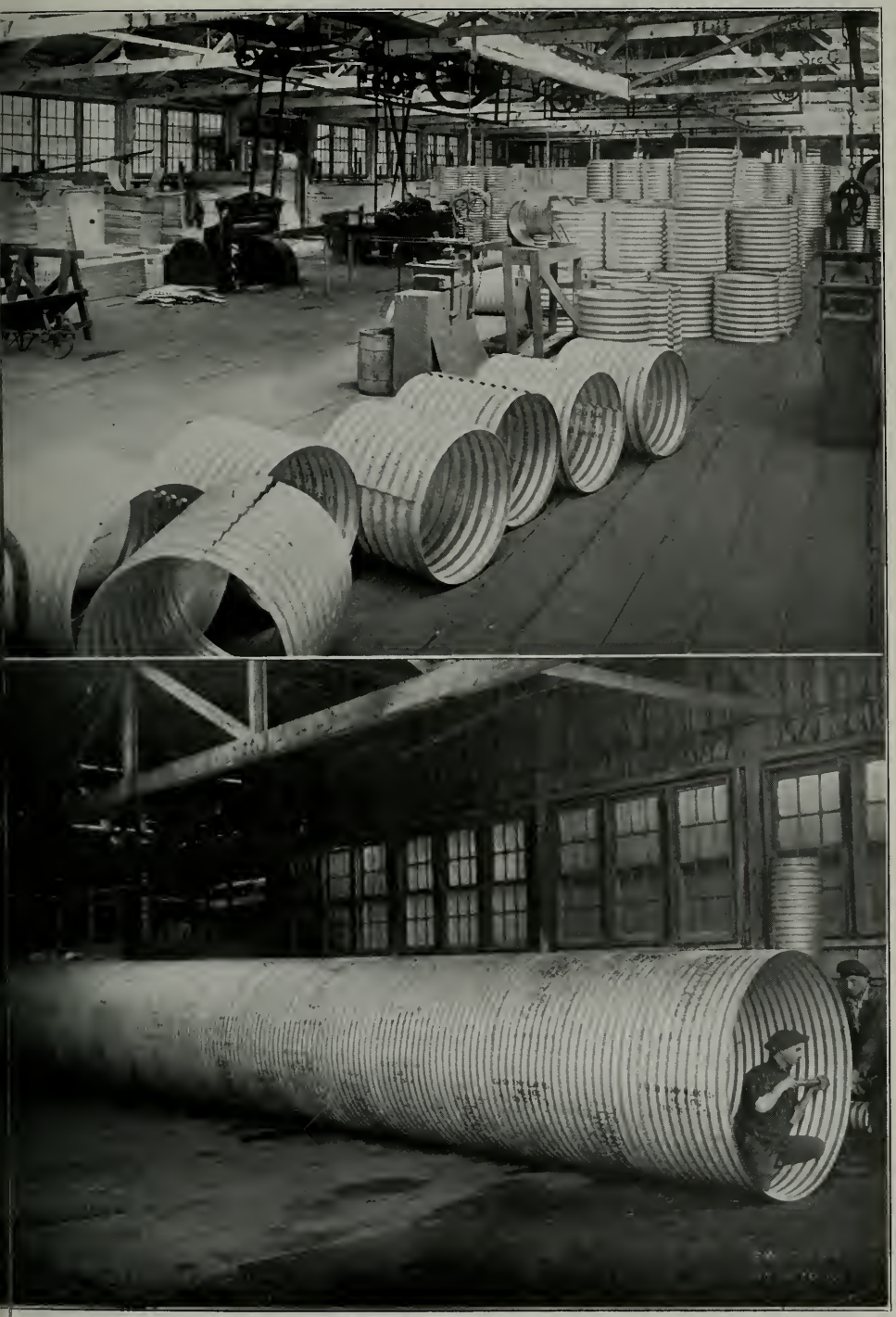
Gasoline, oil and grease, $380,000; culvert pipe, $112,000; hardware, $75,000; tires, $105,000; calcium chloride, $51,000; rock and sand, $162,000; asphalt, $50,000; cement, $50,000; explosives, $100,000; lumber, $50,000. Of the last five items the State purchases only comparatively small amounts, as the contractor buys practically all cement, rock and sand, asphalt, explosives and lumber. Contractors also buy hundreds of thousands of dollars worth of road building equipment.

We operate a fleet of about 1200 trucks and motor cars, in addition to tractors, shovels, etc. In the twelve years since highway work began, the State has purchased over $800,000 worth of culvert pipe.

Another impressive point for business men is the spectacular increase in California's volume of traffic as indicated by registration figures. In 1910 we had 44,122 motor vehicles in the State; in 1920, 563,623; in 1923, 1,118,746; and last year 1,350,759.



WESTERN PIPE & STEEL HAS UNEQUALED FACILITIES FOR THE MANUF
Francisco, Los Angeles, Fresno, Taft, and Phoenix, this company is uncommonly well e
Rolling Keystone Copper steel sheets into circular form. Upper right—The culvert sho
stock of sheets carried. Lower left—Combination punch and riveter, working on round
the U. S. Government.



GALVANIZED CORRUGATED CULVERTS—*With five plants, located at South San e fabrication of culverts. Pictures in this group show typical shop scenes. Upper left— Sa Francisco, showing culverts in the making and, along the distant wall, the enormous e right—A 42-foot culvert, five feet in diameter, fabricated at South San Francisco for*

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CALIFORNIA is facing today what is probably the most crucial situation in the history of her highway project. At a time when the State has a Commission composed of forward-looking, sound-thinking business men, and a highway engineer who has brought new, high standards to the building, maintenance and reconstruction of our roads, the department finds a depleted treasury and no program for further financing of new work. If it were not for Federal aid funds, all work except maintenance and reconstruction would have ceased long ago.

The Legislature will, at the coming session, work out some plan for a permanent program for financing highway building. We commend a careful reading of the articles in this issue by Harvey M. Toy, chairman of the State Highway Commission, and Robert M. Morton, State Highway Engineer. These articles give a straight, business-like account of the situation, and of what is necessary to complete our project, by the two men who know more about the subject than anyone else.

The only way the highway construction problem can be solved is by the people, through their elected representatives, the members of the Legislature. Western Pipe & Steel holds no brief for any particular method of financing the work. Doubtless whatever is the best and most practical plan will be adopted by the Legislature. We welcome the opportunity to acquaint the people with the facts, because an understanding of the facts should be all that is needed to assure a fixed construction program.

This company has a peculiarly specialized knowledge of highway construction problems and highway needs. We have been manufacturing galvanized corrugated culverts for State highways, not only in California, but in Nevada, Arizona, and other neighboring States for a good many years. We regard highway financing as the most pressing issue before the people today.

Under the guidance of C. M. Zander, director of the Highway Department, W. C. Lefebvre, State Engineer, and W. W. Lane, Chief Engineer, Arizona is going forward with a great highway program. These culverts, ready to leave our Phoenix shop, are for Arizona highways.

The Truth About Copper-Bearing Culvert Sheets

PERHAPS the most important and conclusive tests ever undertaken to show the relative merits of copper-bearing steel sheets (such as Keystone sheets, of which Western Pipe & Steel has been making galvanized corrugated culverts for many years) and non-copper-bearing materials, including so-called "pure iron," were held at Pittsburgh, Pa., over a period of six years and three months, from December 12, 1916, to March 9, 1923. All sheets in the test were "uncoated black."

These tests for corrosion were held by the American Society for Testing Materials, a neutral scientific body.

So important does Western Pipe & Steel consider the results, that an authorized reprint of the report covering the failures at the Pittsburgh tests from the copyrighted proceedings of the Society, is enclosed with this issue.

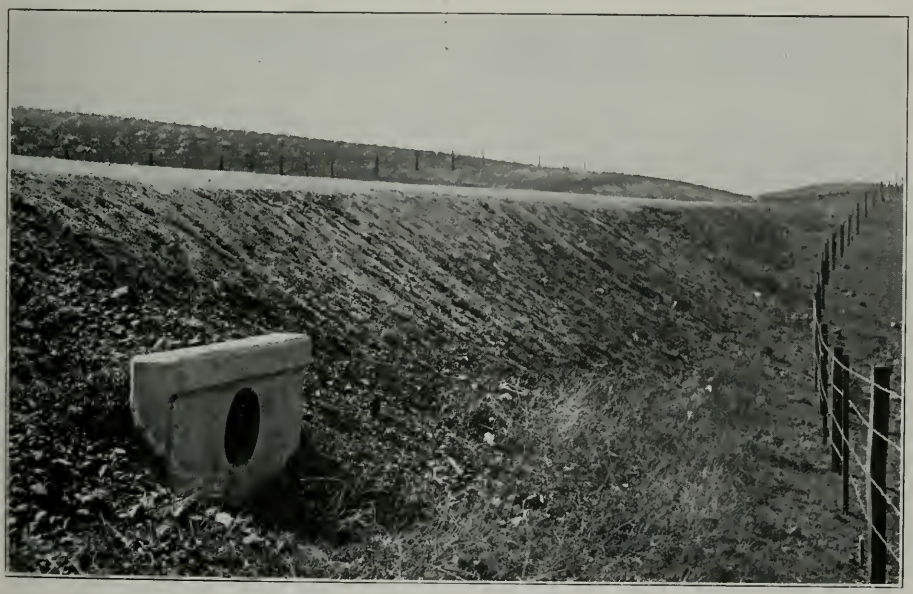
As an introduction to an analysis of this report, it may be pointed out that in the table covering 16 gage sheets the groups marked at the extreme left by the letters HH, II and KK include Keystone copper-bearing sheets, of which all Western Pipe & Steel culverts are manufactured. In the table covering 22 gage sheets the groups marked H, I and K include Keystone sheets.

Analyzing the table of 16 gage sheets, we find that of copper-bearing material fourteen groups submitted a total of 132 sheets. In all this lot not a single sheet failed. Every sheet of copper-bearing steel scored 100 per cent.

On the other hand, the report shows that of 126 sheets of non-copper-bearing material, 13 sheets failed in 28 months; 7 in 35 months; 13 more at 41 months; 8 in 46 months; 14 in 52 months; 25 in 58 months; 8 in 64 months; and 13 in 70 months. Of the original 126 sheets, 102 had failed before the end of the test.

It is interesting to note that 13 sheets of a 17-sheet lot of non-copper-bearing Bessemer steel failed at 28 months.

Even more interesting is the disclosure that of 14 sheets of a so-called "pure iron" product, 8 sheets failed in 41



The Skyline Boulevard is the pride of San Francisco and the California Highway Commission. The picture, showing one of many W. P. & S. culverts, was taken south of Lake Merced.

months and the entire balance failed on the next inspection, 46 months from date of exposure. Thus, while not a sheet of copper-bearing steel failed in the entire period of the test, 6 years and 3 months, every sheet of this particular lot of so-called "pure iron" failed in 46 months.

Tests were conducted simultaneously with 22 gage sheets. Taking first the records on the non-copper-bearing sheets, we find that 84 sheets in 11 groups were in the test. At 16 months it was found that 30 sheets had failed. At 22 months 37 more failed (of these 37 sheets, 30 were designated as "pure iron"). At 28 months 10 more sheets failed, at 35 months 2 more, at 41 months 2 more, at 52 months one, and at 70 months the last two remaining sheets went the way of their non-copper-bearing brothers.

Among the 22 gage copper-bearing sheets, there was no failure whatever in 18 sheets of copper-bearing Bessemer (Keystone) steel. Of 16 sheets of Acid Open-hearth steel, two showed corrosion after nearly five years had elapsed; two more at 64 months, and seven at 70 months. It should be borne in mind that none of these sheets was galvanized.

The net result of the test of 22 gage sheets was that nearly 92% of the non-copper-bearing sheets failed within 2 years and 4 months, while only 13% of the copper-bearing sheets showed any corrosion in nearly 3 years.

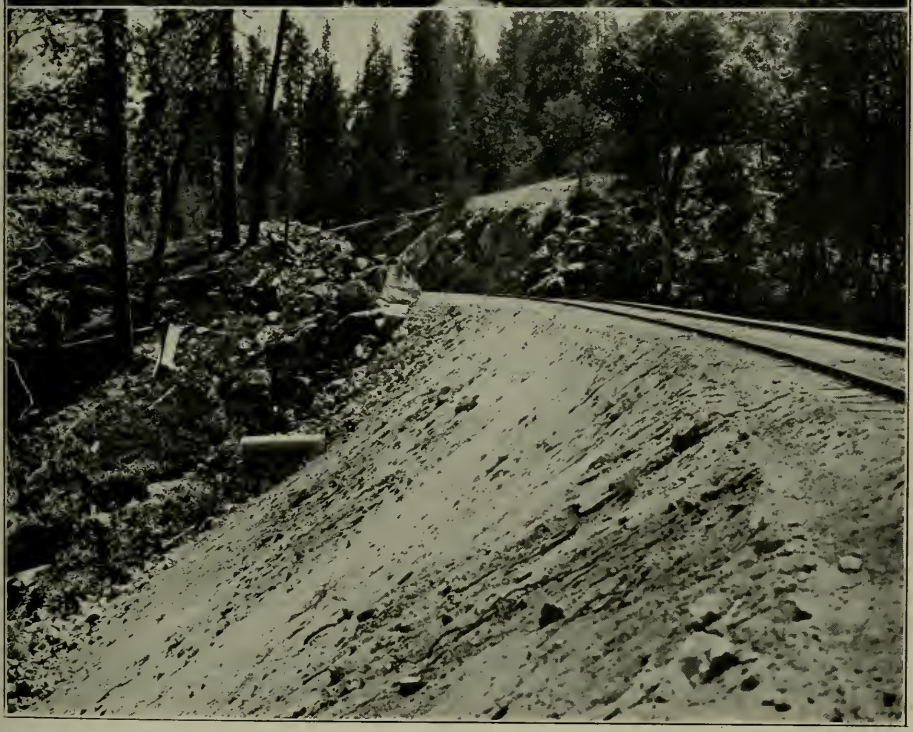
Western Pipe & Steel Co. of California has been manufacturing galvanized corrugated culverts for many years. Thousands of miles of highways, byways and railroads along the Pacific Coast are drained by culverts fabricated by this company, and every one of them is made of copper-bearing Keystone steel, heavily galvanized with a coating that sticks.

We use Keystone copper-bearing steel because it has rust-resisting qualities not found in other materials.

To this high-quality material we add good-workmanship—the only other necessary ingredient to insure long-lived culverts, which mean long-lived roads.

THE COVER—*A picturesque stretch of the Pacific Highway between Redding and Dunsmuir, Mt. Shasta in the distance. Under this pavement, which will ultimately reach the Oregon line, will be found many Western Pipe & Steel Galvanized Corrugated Culverts. A specimen sheet of Keystone Copper Steel frames the picture.*

When the U. S. Bureau of Public Roads built the Blue Nose section of the Klamath River Road, W. P. & S. culverts were transported by mule-pack, 15 miles over mountain trails from the nearest road.



NEVADA BOASTS BEAUTIFUL SCENERY AND GOOD ROADS—*The upper picture shows what Highway Commissioners J. M. Leonard, W. H. Johnston and Geo. A. Campbell, and Engineer Geo. W. Borden and his assistant, Howard M. Loy, are doing for the Silver State. This highway is in Walker River Canyon, between Reno and Yerington. Lower picture shows one of many W. P. & S. culverts on line of the Minarets and Western R. R.*

WESTERN PIPE & STEEL CO. OF CALIFORNIA

"WESTERN"

Keystone Copper Steel Galvanized Corrugated Culverts

are used by

California Highway Commission
Arizona Highway Commission
Nevada Highway Commission
Most Counties in these States
U. S. Bureau of Public Roads
U. S. Forest Service
Southern Pacific Co.
Santa Fe R. R.
Minarets & Western R. R.
Hetch Hetchy R. R.
Sutter Basin Co.
Reclamation District No. 1500
Reclamation District No. 1660

Other buyers of "Western" Culverts include Corporations, Municipalities and Individuals in all sections of the Pacific Coast. Their experience is the same as ours — that no material equals Keystone copper-bearing steel in rust-resistance.

WESTERN PIPE AND STEEL NEWS

A WESTERN PIPE & STEEL WELDING CREW ON A RECORD-BREAKING JOB—
On this E. J. Miley well, Athens field, near Los Angeles, a W. P. & S. crew landed and cemented 1260 feet of 16" casing in ten hours and 35 minutes. This is one of the longest strings of this type of casing ever set.

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME II MARCH, 1925 NUMBER 3

Western Pipe & Steel Oil Well Casing Gives Satisfactory Results

By R. A. BROOMFIELD

General Manager, Barnsdall Oil Co. of California

TO those who have participated in the development of the oil industry in California, especially within the last two decades, its spectacular growth from small beginnings to its present tremendous production volume, capital investment, and far-flung fields, has been a source of constant wonder. Not the least interesting phase of the development has been the progress made in devising new and improved equipment wherewith to simplify, cheapen and expedite operations in the great task of getting Mother Earth to give up her liquid treasure. The ingenuity displayed in this matter of improving apparatus and equipment is a credit to the high order of intelligence that is characteristic of the oil business. More, this apparently unlimited ingenuity is the answer of resourceful men to any and all statements that "it can't be done." The history of no other industry discloses such radical improvements over crude original methods. I do not even except the automobile industry, with which the public at large is more familiar, and in which changes have been so revolutionary that it is hardly an exaggeration to say that the motor car of today bears no resemblance to its ancestor of twenty years ago, save that both have four wheels.

R. A. BROOMFIELD

Of particular interest in the oil industry is the sharp contrast between the oil well casing and awkward installation methods of a few years back and the standards of today. In that earlier time, when the type known as stovepipe casing began to come into use, things happened which are laughable now, but which were near-tragedies then. First we had loose-joint pipe. Then somebody thought of riveting the short sections together in the shop, which reduced the number of field joints but was still a source of difficulty. Then came the days of the famous "hand-picked" casing, in which the men in the field actually indented the pipe with picks. There are old-timers in the industry who can still weep and curse at the thought of those old days.

The Barnsdall Oil Company first used this old-fashioned hand-picked casing back in 1910. It should be borne in mind that this casing was not reinforced. Handling casing as it is fabricated today—welded, reinforced and dipped—is actually a pleasure compared to the old days.

Our company was a pioneer in the use of the modern improved conductor string

casing as manufactured by Western Pipe & Steel Co. of California. We began using it on the Howard Park One Well. We got the acreage together in May, 1921, and the well was started in September, 1922. We have been steady and consistent users of "Western" oil well casing ever since, so it goes without saying that our experience has been more than satisfactory. It is of course obvious that cement water strings must be absolutely tight in order to avoid trouble in pumping cement through. We have encountered no difficulty in this regard with "Western" casing.

Recently we brought in three wells on the O'Dea property in the Athens field on each of which we set about 1000 feet of sixteen-inch "Western" casing, welded the joints and pumped cement in an average of twelve hours. I might add here that of these three wells, O'Dea No. 3—4369 feet—was finished and on production in just 90 days.

In the Rosecrans field we installed "Western" casing in five wells with perfect success. On these wells the length of the water string averaged 4100 feet, and we experienced no difficulty in working through the conductor casing. Of the nine wells referred to above, six have already been put on production.

Not only have I had most satisfactory experience with "Western" oil well casing, but in addition, I have made it a point to familiarize myself with their methods of fabrication and their field service. I know of one job where a Western Pipe & Steel field crew landed and cemented 1260 feet of sixteen-inch casing in the remarkable time of ten hours and thirty-five minutes. This, I believe, is one of the longest strings of this type of casing ever set. In the old days this would have required not less than two and possibly three or four days, at a cost that would be prohibitive under the present scale of wages.

Two Western Pipe & Steel 500-barrel bolted tanks used as flow tanks by Barnsdall Oil Company at O'Dea 3, Athens field. Fred Fortine, standing between the tanks, is the able Barnsdall superintendent.

MANUFACTURING AND INSTALLING W. P. & S. OIL WELL CASING—*Top—Shop view showing casing in process of manufacture at Los Angeles. Lower Left—W. P. & S. field crew installing casing for E. J. Miley. Lower Right—Another view of the Miley well showing 30-ft. joint in the elevator.*

Thirty Years of Water Well Work

By S. F. Catey

Underground Water Development Engineer

WELL development, as now perfected, is an exact science; based, like all sciences, on things known, plus common sense. The hit or miss, hope-we-strike-water methods of our fathers and forefathers back to the dawn of history, are as obsolete as the one-cylinder automobile.

I have been in the well business thirty years. In my thirty years experience I have developed over 1300 wells, ranging in territory from Fresno to El Paso, with a few across the Rio Grande in Mexico. I have also acted as consulting engineer for railroads, land companies, sugar companies, and municipalities. In fact there is scarcely a large city, irrigating company, or farm company in this territory that I have not served. I have demonstrated to them, as I shall try to show in this article, that well development is an exact science, with no guesswork about it, and that the greatest factor in it is common sense.

When I started, back in 1896, we used 4-inch casing. Much of the drilling equipment then in use was hand equipment. Those were the days of the earth auger and the wooden rod. Then came the horse power rig. Afterwards, but a considerable time afterwards, we began to use cable tools, first operated with a windlass, but later, as now, by steam or gas engine.

In the old days the average depth of wells in California was less than 100 feet, and we generally used 16 gauge casing. Of course these shallow wells were in the lowlands of which the country around Sacramento is typical. Late

S. F. Catey of Los Angeles, standing beside his rig on a 1500-foot well for the City of Huntington Park. He used W. P. & S. 18" casing on this well, which will yield 1,000 G. P. M.

in 1896, which was the third year in a dry cycle that lasted until 1904, deeper wells were found necessary, and soon the average well was from 350 to 400 feet. These were mostly flowing wells. It was not until about 1900 that pumping started. It was about this time, too, that wells began to replace tunnels.

After 1900 there set in great activity in developing more water for irrigation and large pumping plants came into use, at first with crude steam plants. We began to drive wells from 600 to 800 feet and even 1000 and 1100 feet for water, and many old wells were deepened, both flowing wells in the low country and pumping wells in the high basins.

A word now about casing. Thirty years ago it was 4 inch diameter, 16 gauge, single string. Then as wells grew deeper and the casing larger we used 12 gauge sheets. A little later it was 10 gauge, and double casing. In 1897, after conferences of well men and manufacturers, we put in some 10-inch casing made of 8 gauge sheets. From this time up to 1900 the standard size was 10-inch with some 12-inch casing here and there. After 1900 larger diameters, up to 16-inch (which was then considered very large), came into regular use, with 10 gauge material as standard.

I recall that 16-inch casing held as the maximum size up to about 1906-7, with only an occasional use of 18-inch. Then larger sizes suddenly developed to accommodate deep well turbines and sizes as large as the largest we use now were brought out.

What really set the public to thinking about large wells was our construction, in 1908, of a well for the Azusa Irrigation Company 400 feet deep, with 26-inch casing, that produced 412 miners inches or 3708 gallons of water per minute. This so impressed the bankers and others interested that more wells followed until they now have eight. This 1908 well was first planned for a depth of 140 feet, at which it was expected to produce 40 miners inches. But knowing that the heavy gravels of the San Gabriel delta formation would produce a great deal of water, we advised a larger well, figuring that we could perhaps get 200 inches. However, we advised the installation of a pump with a capacity of 300 inches (a deep well turbine) and we actually got 412 inches.

As a matter of fact, we advise, and even insist on the use of large casing, especially in boulder ground, for the very good reason that pipe can be handled without danger of divergence. In other words, it gives us a chance to break up the rock and get it out.

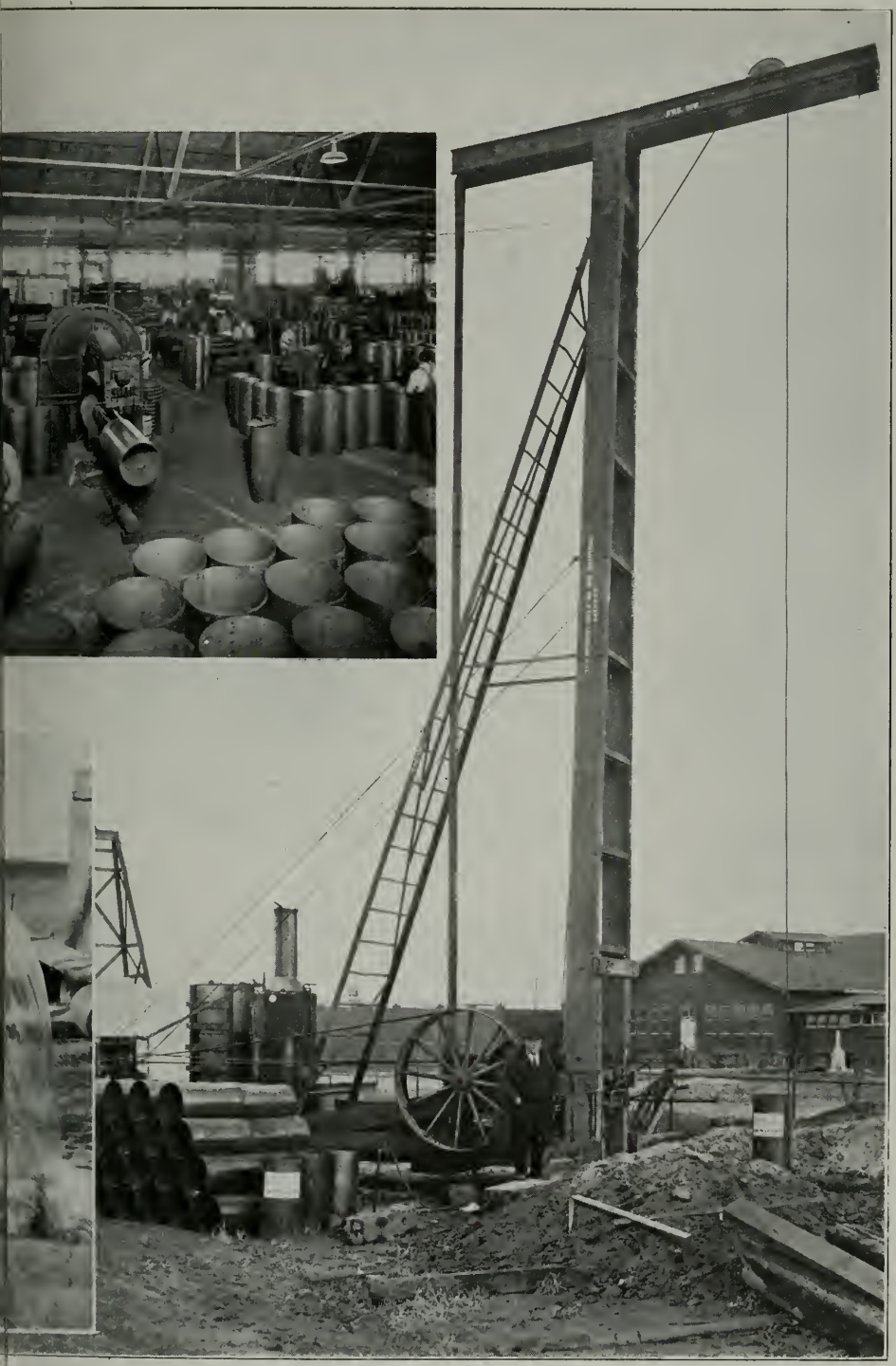
Another large well in those days was one we constructed in 1909 for the Glendora Irrigation Company. This was 710 feet deep, with 24-inch casing, a single line through very difficult ground.

The deepest water well that I know of in Southern California is at Tustin. It is down 1800 feet with 12-inch casing. There are many wells around Long Beach 1000 and 1200 feet deep. The deepest well I have a log of in the old days is one I put in at Bell Station, in 1898, where I used 1365 feet of single string casing. My largest well was constructed for the Puente Cooperative

(*Continued on page* 12)

Again we find a Catey rig and W. P. & S. casing together. The well is for Hugo Carlson, Camarillo.

FROM SHOP TO FIELD WITH WESTERN PIPE & STEEL OIL WELL AND
Angeles plant of W. P. & S. Left—Barnsdall Oil Company's O'Dea No. 3 well, Athens
was on production 90 days after drilling began. Right—One of S. F. Catey's rigs develop
18" W. P. & S. casing was used. Lower Inset—An artesian well on which W. P. & S. 1
Farms Company southwest of Fresno. D. P. Bramlette was the contractor.



LL CASING—*Upper Panel—View showing part of the well casing shop at the Los W. P. & S. special oil well casing was used. This famous well is* 4,369 *feet deep and for the City of Huntington Park, near Los Angeles. The well is* 1500 *feet deep and used. The well, which is* 1100 *feet deep, is on the property of the San Joaquin Irrigated*

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EDITED BY EDWARD F. O'DAY

WE sincerely hope that the individual, municipality or corporation with a well problem to solve will find much valuable information in this number of *Western Pipe & Steel News*. Water well problems are discussed by such well-known authorities as S. F. Catey of Los Angeles, P. E. Vaughan of San Jose, and D. P. Bramlette of Fresno. We are glad to be able to broadcast such helpful information for the benefit of our readers, and we are proud of the unanimity with which these experts praise the well casing manufactured by this company.

On the subject of oil well casing, we present an interesting and instructive article by R. A. Broomfield, general manager of the Barnsdall Oil Co. of California. He is recognized as one of the leaders in the oil industry in this State, and was not only one of the pioneer purchasers of "Western" oil well casing, but has used it consistently for many years. Many other oil men share his views regarding our products and we shall take pleasure in presenting them from time to time.

To Mr. Broomfield's words we can only add the information that "Western Oil Well Casing" is economical in cost and installation; service includes delivery in the field, furnishing elevators, spider and slips, and a crew of expert welders with full equipment under the direction of a skilled foreman.

Made of special hard red steel, of the most rugged construction, reinforced, properly welded and riveted and dipped, "Western" oil well casing merits the high praise bestowed upon it by all who have used it. When quality of materials and quality of workmanship are joined with good service, reputations are achieved.

Western Casing in the San Joaquin Valley

By D. P. BRAMLETTE

IF the proof of the pudding is in the eating, it is obvious that the best evidence of the dependability of quality of material and workmanship in water well casing is to be found in the consistency with which a well contractor uses it. It follows, then, that the best possible recommendation I can give Western Pipe & Steel water well casing is to say that I used it in all of the wells listed in this article, as well as in scores of others, mention of which space forbids:

San Joaquin Farm Lands Co. (now known as James Irrigation District)—100 wells, 12" diameter, average depth 1100', all artesian wells. Water flows one to two inches over top of pipe.

Stinson Irrigation Co.—22 wells, 14" in diameter, ranging from 500' to 1200' in depth, No. 12 gauge double casing. These wells average 1350 gallons per minute. (*Continued on page* 10)

A Bramlette rig near Fresno, showing W. P. & S. Well Casing.

Gravel Envelope Wells

By P. E. VAUGHAN, *President*
Western Well Works, Inc.

FOR the past nine years Western Pipe & Steel casing has been used exclusively by the Western Well Works, Inc., of San Jose, California, in the construction of our patented Gravel Envelope Wells. This casing is specially manufactured, according to our own specifications, in their shops at South San Francisco.

In the construction of the Gravel Envelope Well, a preliminary test hole is bored and samples of the different water-bearing formations are secured and carefully logged.

After the test bore is completed, and the size and depth of the finished well have been decided on, the casing is fabricated. A sufficient number of joints are perforated to take care of the water-bearing formation indicated by the log of the test bore.

This casing is then sent to the well site, where the joints are welded together and lowered into the bore in one continuous string, with perforated sections opposite the water strata. The well is then finished by placing gravel around the casing in the hole according to our patented Gravel Envelope process.

During the past nine years, the Western Well Works have constructed hundreds of wells, ranging in depth from 500 to 1300 feet, using Western Pipe & Steel specially constructed casing. These wells are yielding from 500 to 4000 gallons of water per minute.

With our method of water development, it is seen that no casing is installed except where the test bore log indicates a water yield. Every foot of casing installed in "Western" wells, therefore, has functioned as a water conductor continuously from the time installed, and, during this period of years, the record of Western Gravel Envelope Wells has been 100% successful.

Rotary rig of Western Well Works, Inc. (San Jose), constructing well on 300-acre ranch of Elmer Bros. nursery, in Santa Clara County. Picture shows W. P. & S. special casing, 16" diameter. The well is 600 feet deep, 1,000 G. P. M.

Twelve New Wells Near Oxnard

By J. W. Rooney

Manager, Oxnard Factory, American Beet Sugar Co.

As a part of its plan for the development of about 6000 acres of land recently acquired southeast of Oxnard, the American Beet Sugar Company is constructing twelve sixteen-inch wells, and will install pumping plants, dig drainage canals and ditches, and put the tract under irrigation and drainage.

Of the twelve wells, eight have already been drilled and perforated, the depths varying from 400 to 1000 feet. The indications are that fairly good flows of water will be had from most of the wells. Two of the wells are being pumped at the present time. Contracts have been let for the drilling of the four additional wells.

The area comprising the 6000-acre tract consists mostly of farming lands now under cultivation. The company's original holding of approximately 1500 acres lies adjacent to and north of the newly acquired property. Dykes for the control of flood waters are embraced in our development plans. About fifteen miles of drainage ditches have been completed as well as some of the dyke lines.

It is planned to complete the entire project within a year, after which we believe this will be one of the most profitable farming districts in the country. The engineering firm of Salisbury, Bradshaw & Taylor have charge of the development plans and work. Sam Beard is the contracting driller on the water wells, and the well casing is being supplied by Western Pipe & Steel.

American Beet Sugar Co.'s Well No. 8, Ventura County. Drilling at 995 feet. Western casing used.

San Joaquin Valley

(*Continued from page* 8)

Burrel Irrigation District—10 wells, 14″ in diameter, average depth 800′, all delivering about 1350 gallons per minute.

W. O. Miles Ranch—4 wells, 24″ in diameter, averaging 350′ in depth. Each well delivers 3000 gallons per minute.

Wappato Gun Club, Dos Palos—Two wells 14″ in diameter, 750′ deep. Artesian wells flowing 800 gallons per minute.

Fresno Irrigation District—One 18″ well with No. 10 gauge double casing, 308′ deep. This well is delivering 2000 gallons per minute.

Los Angeles Athletic Club, Conners Station, near Bakersfield — One 14″ well, 900′ deep. This well has just been completed.

Wylie M. Giffen Ranch (Weed Patch, near Bakersfield)—One 20″ well, 400′ deep. This well is pumped with a 200 horsepower motor which lifts the water approximately 150 feet, 3000 gallons per minute.

City of Delano—One 14″ well, 1200′ deep, which is delivering 1200 gallons per minute.

Irrigation in Ventura County

By Richard Bard

President, Zone No. 1 Mutual Water Co.

SINCE the placing of water on the land in this region through the completion of the Zone Mutual Companies system, there has been a growing tendency on the part of farmers to get water. Various estimates have been made as to how much the water increases the value of the land, but it is safe to say that this increase amounts to approximately $200 per acre. The water insures crops to the farmer whether it rains or not. In a dry year such as 1924 our water development made it possible for the farmers in the Las Posas district to raise 2,130,000 pounds of lima beans on 1600 acres where, without irrigation, no crop would have been raised at all.

During 1924, some 2500 acre feet of water was delivered to users for which they paid the companies $18,250. This investment in water returned to the users, in lima beans alone, $240,000, or more than enough to pay the entire cost of our Zone No. 1 system.

The project for an irrigation system in the Las Posas valley was started in 1919. In 1920 the first test well was sunk, followed by another in 1921. Both were satisfactory. Reports show that the watershed of Las Posas creek comprises 128 square miles, and that about 12,000 acre feet of water are stored each year in the underground reservoirs. At present the companies have three wells operating which produce a combined flow of about 430 miners inches. A new well has just been completed which is expected to increase the supply to 700 miners inches. We consider that both our systems are now complete except for additional water development, such as more wells and equipment. Western Pipe & Steel have been furnishing our casing.

Well drilling outfit finishing up Coco (California Orchard Co.) Well No. 4 near King City. Western casing was used.

(*Continued from page* 5)

Water Company in the Azusa District near Baldwin Park. This is a 26-inch well which has been flowing 565 inches for about six years. This large well did away with an old pumping plant and a string of small wells.

An important advantage in big wells is that they can be watched and as the water table lowers it is possible to lengthen the column and lower the pump without changing anything.

Now, something as to why I say water boring is an exact science. The basis of the science is the geology of the country. Of course, wells can be dug almost anywhere that will give enough water for domestic purposes. What we are discussing is large quantities for irrigation.

If the country is so formed as to store water underground, it will give water in large quantities. If it is not so formed, all the expert well diggers in the world can't get water out of it, and there is no use sinking any wells.

Let me illustrate. In Southern California the country between the mountains and the foothills, and also the coastal plain, is geologically of the quaternary or recent period. After the high mountains rose, the torrential waters seeking the sea carried with them rocks and boulders into the valleys, and in the course of ages these low places were filled up with silt and sand and so formed the country as it is today. Therefore, when we know the geological structure as we know it here, we are never in any doubt as to whether there is underground water present. The San Bernardino valley lies over one of the greatest subterranean water formations in the country. The San Fernando valley is another. Antelope valley is another. But south of the coastal plain, that is, from the south line of Orange county to the Mexican border, there is no underground water to speak of.

This makes it plain that our policy of making every well a special case and treating it according to the strata encountered is the common sense plan. And this explains the variation in perforations, of which there are three types: the chisel slot, from $\frac{1}{16}''$ to $\frac{1}{8}''$ wide and 1″ long; the punch slot, about $\frac{1}{2}''$ wide and 5″ long; and the ripper slot, 1″ wide and from 12″ to 14″ long. During the drilling of each well we keep samples of the different strata encountered and perforate the casing accordingly.

I consider the development of a well with the air compressor as important as the drilling of the well itself. As to stovepipe casing, the reason we can handle it to advantage, especially at such great depths, is because it has no couplings. In other words, we couldn't handle screw pipe because of the couplings.

Another important factor in favor of stovepipe casing is the enormous end pressure it is capable of standing. I have put as high as 200 tons end pressure on a string of 12-inch, 10 gauge casing. Incidentally, this was Western Pipe & Steel casing.

I want to say here of Western Pipe & Steel that they are, and have been for many years, manufacturers of as fine a quality of well casing as it has ever been my good fortune to handle. I am familiar with their product as a result of using vast quantities of it; I am familiar with their manufacturing methods, which I thoroughly approve; and I know that they use only the best quality of hard red steel, which is the proper material for well casing. Furthermore, I know that in Western Pipe & Steel Co.'s shops every joint of well casing is lathe-trimmed and fitted, to insure perfect fit and alignment in the field.

THE COVER PICTURE—*This is one of the E. J. Miley wells in the Athens field near Los Angeles. A Western Pipe & Steel field crew landed and cemented* 1260 *feet of sixteen-inch "Western" casing in ten hours and* 35 *minutes, which is believed to be record time for such work. The string is one of the longest ever set. Practically every operator in the Southern California fields is now using this type of casing.*

OIL INDUSTRY EQUIPMENT AND APPARATUS

MANUFACTURED BY

WESTERN PIPE & STEEL CO.

OF CALIFORNIA

Absorption Plants
Accumulators
Acid Tanks
Agitators
Air Receivers
Boilers
Bolted Steel Tanks
Condensor Boxes
Cooling Towers
Culverts
Dephlegmators
Electrically Welded Pipe for Gas Gathering Lines
Evaporators
Filters
Fire Stills
Galvanized Corrugated Steel Tanks
Gas Traps
Gasoline Storage Tanks
Gasometers
Grease Kettles
Heat Exchangers
Heaters
Oil & Gas Separators
Purifier Boxes
Refinery Equipment
Retorts
Riveted Steel Tanks
Smoke Stacks
Steam Stills
Steel Filling Stations
Steel Plate Construction
Stovepipe Casing
Structural Steel Buildings
Tank Supports
Truck Tanks
Welded Tanks
Western Oil Well Casing

Among the Many Users of

"WESTERN" Oil Well Casing

are the following:

BARNSDALL OIL CO. OF CALIFORNIA

E. L. BLANTON

CHANSLOR-CANFIELD MIDWAY OIL CO.

CHICKSAN OIL CO.

GENERAL PETROLEUM CORPORATION

MCGINLEY OIL CO.

E. J. MILEY

MOHAWK OIL CO.

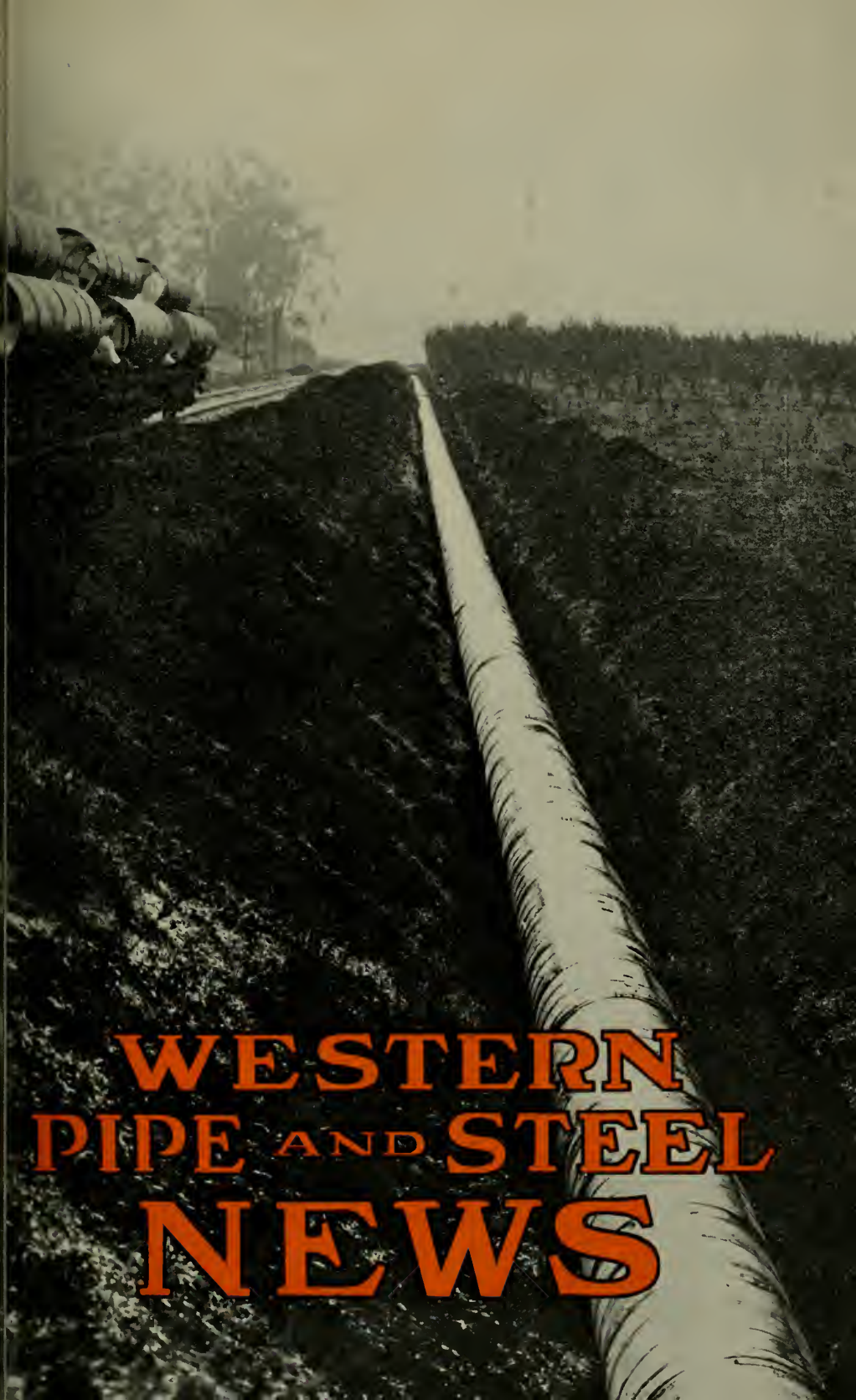
W. R. RAMSEY

STAR PETROLEUM CO.

UNION OIL CO.

UNITED OIL CO.

WILSHIRE OIL CO.



WESTERN PIPE AND STEEL NEWS

These pictures were taken over ten years ago, when the two projects described by Mr. Kieffer in this number were under construction. Upper picture shows Western Pipe & Steel wrapped pipe distributed along the trench, Lindsay-Strathmore Irrigation District. The lower picture shows part of a trainload of soil-proofed pipe for the Terra Bella Irrigation District. These two districts used more than 160 miles of this soil-proofed pipe, ranging from four inches to thirty-six inches in diameter. Today the pipe is in as good condition as when it was placed in the ground.

Contrasting with these views of an early installation of Western Pipe & Steel soil-proofed pipe, there is presented on the cover of this number a recently made picture of the new line of Spring Valley Water Co. from Niles Reservoir to a junction with the Hetch Hetchy Bay Crossing Division at Irvington. This line is 44 inches in diameter, and is the last word in manufacture and installation of wrapped pipe.

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VOLUME II APRIL, 1925 NUMBER 4

Soil Protection of Steel Pipes

By STEPHEN E. KIEFFER

Consulting Engineer

DEVELOPMENTS of recent years have resulted in methods of coating and covering riveted and other light steel pipes that mean a complete change in the life history of such pipes, and a revision of depreciation estimates.

The engineer who is abreast of the times can no longer be justified in placing a life of twenty years or less upon light steel pipes, no matter how destructive the soil.

STEPHEN E. KIEFFER

Western men, western initiative and western methods are responsible for the change. A new idea in engineering, as in medicine or the sciences, calls for men who are not afraid to test their theories in the school of experience, which alone can give the verdict of success or failure.

The American, and particularly the Western American, has ever been willing to abandon precedent and adopt new ideas to fit his needs.

Had the railroad construction standards of Great Britain and continental Europe been the only measure of such development the United States would never have been built up. The apparently flimsy roadbeds and structures of the American railroads scandalized the Old World, with its dense population; but nothing else would have met the needs of great mileage to open the vast new country, and nothing else could or would have been possible and met the needs of the people. The American mind was ready to concede quality for quantity until population and business permitted the higher standards.

Had the water pipe standards of the heavily populated East been adhered to, the West, with its need for water distribution, would have been slow to advance. The expense would not have been justified. California may almost be said to have had its foundation laid in the flimsy (by Eastern standards) but cheap, riveted "stovepipe" pipelines of its early days.

The mines of California never could have been developed except for these cheap pipes. Necessity was the mother of invention. Everywhere today on the ridges and in the canyons of the Sierra are remnants of those early pipelines, many of them brought around the Horn.

As the mines faded the population shifted to the opening valleys, and took with it for its irrigation and domestic needs the light and cheap riveted pipe of the mountains and mines.

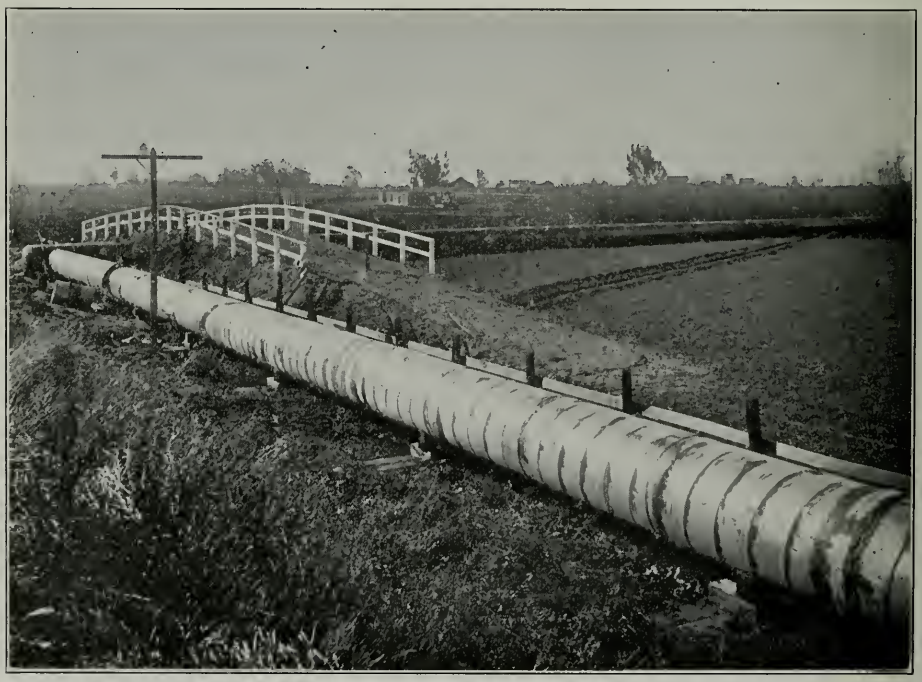
But with the transfer to the valleys new soil conditions were encountered. The wrought iron of earlier days was superseded by less durable steel, and the favorable foothill soils by the alkali soils of the plains. The life of light riveted steel pipes was short, about twenty years or less. The asphalt dip was relied on to protect the steel, but experience showed this to be a most unreliable and short-lived protection.

Many efforts were made to protect the pipe with covering applied over the asphalt dip. Ordinary burlap saturated with asphalt was tried. This failed, not only because of the flimsy texture of the fabric, but because of improper application, particularly where the wrapping was applied to the pipe after laying in the trench. An imperfect bond between the pipe and the wrapping permitted the penetration of alkali-laden water to the pipe shell, with resultant destruction.

Pipe corrosion and destruction never come from the inside; always from the outside through soil water impurities. This has been particularly demonstrated in oil carrying pipelines through the San Joaquin Valley, where the interior has been protected by the oil, and exterior destruction due to impure soil water has been most rapid.

After burlap the next effort at protection was with ordinary roofing felt, wrapped on cold pipes. This failed because of non-resistant materials and poor bond with the pipe, resulting in poor water seal.

Finally in 1914 the first systematic and studied efforts at a proper solution of the problem were undertaken. Two requisites were demanded: first, a wrapping of proper texture and strength; second, proper application to the pipe.



View of Spring Valley Water Co.'s 44-inch soil-proofed line near Irvington; Hetch Hetchy line in distance.

The first condition was met in 1915 by the Paraffine Paint Co., with a close-textured rag felt that was strong but pliable, impregnated under pressure with a highly refined asphalt, coated on both sides with a thin film of alkali-resistant compound, and one surface flaked with mica to offer a cleavage plane to permit of heavy contracting soils drawing away from the pipe when dry without pulling away the wrapping and breaking the water seal.

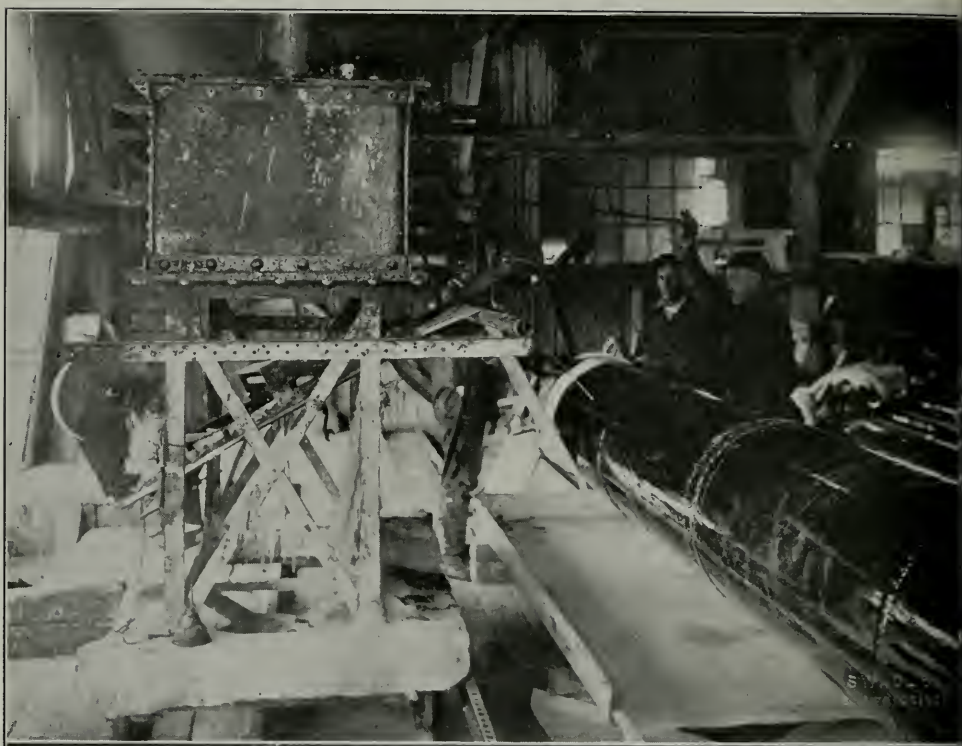
The second condition was met by specially designed machines which wrapped the pipes in the shop with a spiral winding of the felt. The pipe to be wrapped is mounted in the machine while the steel shell and asphalt dip are still warm from the dip kettle. As it is revolved a carrier travels along the pipe and the felt is wound on with a pull of 50 lbs. to the 12-inch strip, at the same time hot asphalt being fed on the strip at the point of contact with the pipe. This results in a perfect bond of the felt with the pipe that never lessens and absolutely water-seals the pipe shell. The wrapping when cold is not easily abraded, will stand rough treatment in transit and laying, is easily patched where broken in handling, and to all appearances is everlasting. Field joints are sealed in the trench by hand-wrapping with a 12-inch strip of felt and sealing with hot asphalt.

In 1916 and 1917 the first large pipe systems wrapped in this manner were laid by the Western Pipe & Steel Company for the Terra Bella and Lindsay-Strathmore Irrigation Districts in the San Joaquin Valley. Some 250 miles of pipe from 4-inch to 36-inch diameter were protected and laid in heavy adobe soils, where experience had shown the life of unprotected light steel pipes to be about five years.

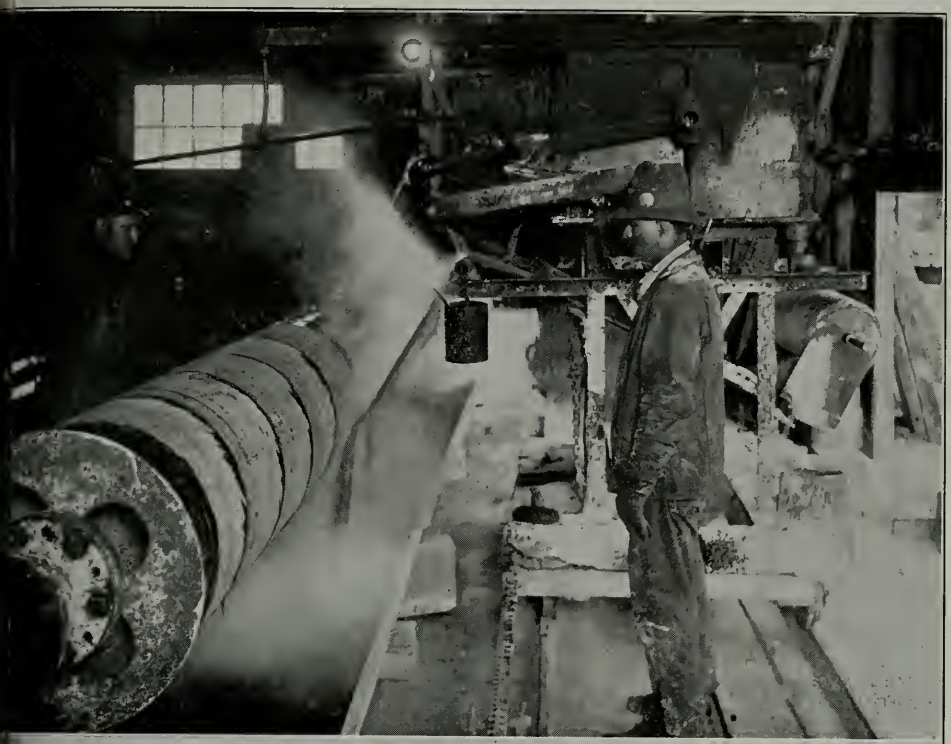
After nine years these pipelines, when opened for connections or changes,

(*Continued on page* 8)

Spring Valley Water Co.'s line along Western Pacific tracks between Niles and Irvington, Calif.



SHOP PICTURES TAKEN AT W. P. & S. SOUTH SAN FRANCISCO PLAN
steel pipe, 30 feet long. UPPER RIGHT—*Half way. The steam is from the hot asphalt co*
spread of the dip is shown by the black smudges along the seams. LOWER RIGHT—*Soil-p*
work illustrated by these pictures is described in detail in Mr. Kieffer's article in this nu



ING HOW PIPE IS WRAPPED. Upper Left—*Starting to wrap a section of 22-inch wing under the wrapping.* Lower Left—*The section completely wrapped. A proper ping on special fittings, showing the careful manner in which it is applied. All of the*

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EDITED BY EDWARD F. O'DAY

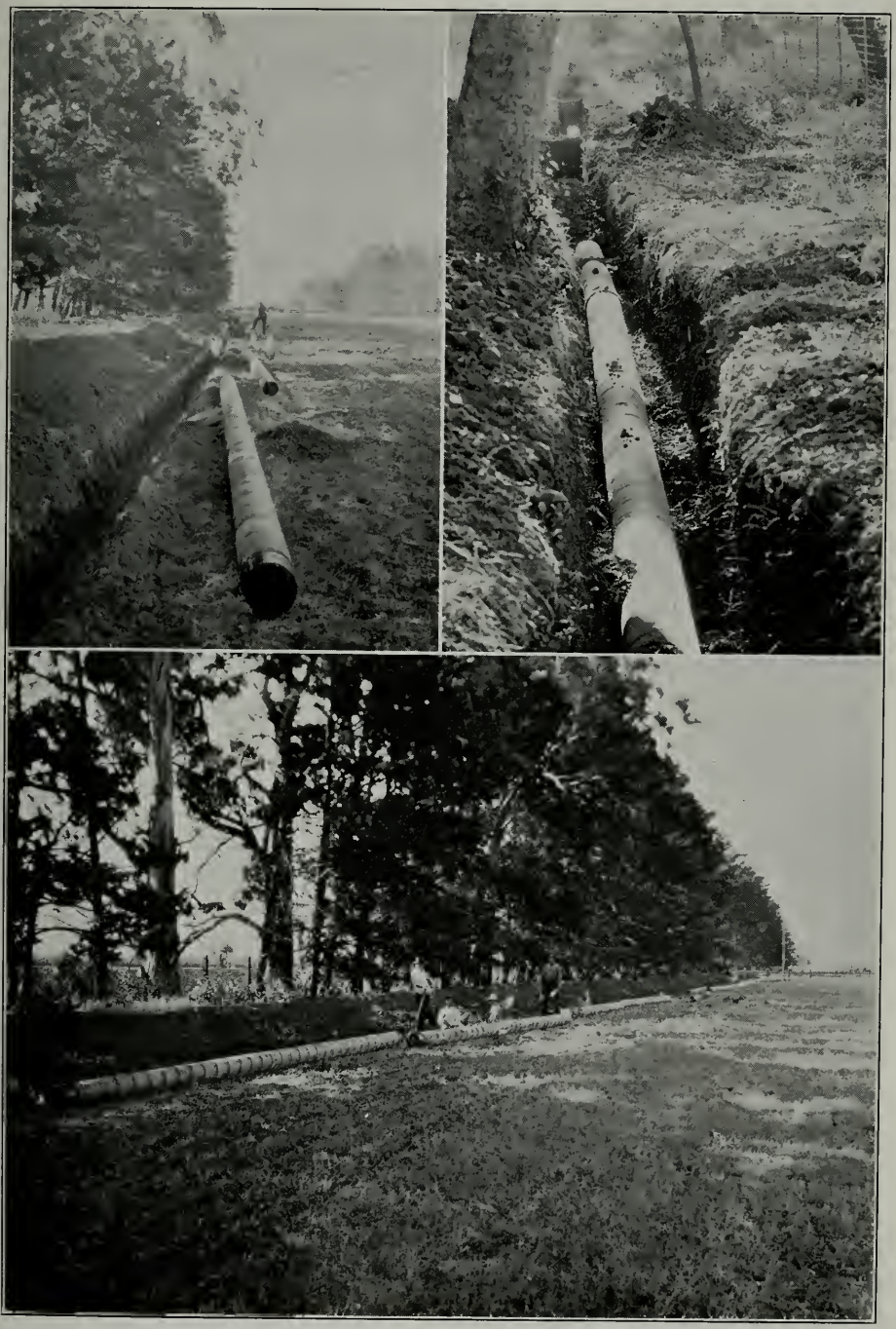
THIS month station WP&S broadcasts an article on soil-proofing steel pipe by Stephen E. Kieffer, consulting engineer. Mr. Kieffer is more than an authority on soil-proofing, he is in fact the father of the process. His article describes the beginnings of the art, but it does not tell the story of the bitter opposition on the part of some engineers on account of the failures of the first crude attempts at wrapping steel pipe in a soil-proof covering, nor how the idea finally prevailed after the designing and perfecting of special machines to do the work.

Mr. Kieffer was engineer of the two big projects mentioned in his article—the Lindsay-Strathmore and Terra Bella Irrigation Districts—and he has been identified with many other projects where his experience has saved many maintenance-dollars for owners.

In 1896 he built the pipe-line for the Fair Oaks project in the Sacramento Valley, a line about 40 miles in length. The rebuilding of this line began in 1919 and is now practically complete—with wrapped pipe. The original line was not wrapped and there were constant heavy maintenance charges. There have been no maintenance charges whatever where wrapped pipe has been installed. The success of wrapped pipe on this project has been so striking that not a foot of pipe goes into the ground now unless wrapped.

It is experiences such as these that move Mr. Kieffer and a good many other engineers to advise, and even insist upon, the installation of wrapped pipe. While it adds a few cents per foot to the first cost of the pipe, it gives incalculable years of added life, to say nothing of reducing maintenance charges to almost zero. Buyers of pipe should bear in mind that *pipe is destroyed from the outside.* To paraphrase a familiar slogan, "Save the outside and you save all."

W. P. & S. 20-inch soil-proofed pipe awaiting installation at Bascome Ave. pump station yard of San Jose Water Works.



INSTALLATION FOR BEAR GULCH WATER COMPANY. *These views show part of a 6100-foot line of 10-inch soil-proofed pipe recently installed to serve the City of Menlo Park, Calif.*

(*Continued from Page 3*)

have been found as perfect as the day they were installed, and the wrapping can only be removed with a cold chisel. Depreciation is apparently nil, and the life of the pipe is beyond prediction.

Similar results have been obtained elsewhere in a great variety of soils.

Since the first large scale soil protection of light steel pipes, referred to above, the practice has become almost universal, until now probably 90 per cent of all such pipes laid are similarly protected.

This method of soil proofing can safely be said to have "arrived" to stay. How widely its use will extend is hard to predict. Nor can its economic value, and great saving to the resources of the State in lengthened life of pipe structures, be estimated.

A 16-inch wrapped pipeline for the City of Beverly Hills.

Standard Practice in Pipe Wrapping

IN the April, 1924, number of WESTERN PIPE & STEEL NEWS, long since out of print, there was featured an article by Mr. G. A. Elliott, Vice President and Chief Engineer, Spring Valley Water Co., in which he discussed wrapped pipe. There have been many requests for this article, which are now met in part by reprinting the following excerpt:

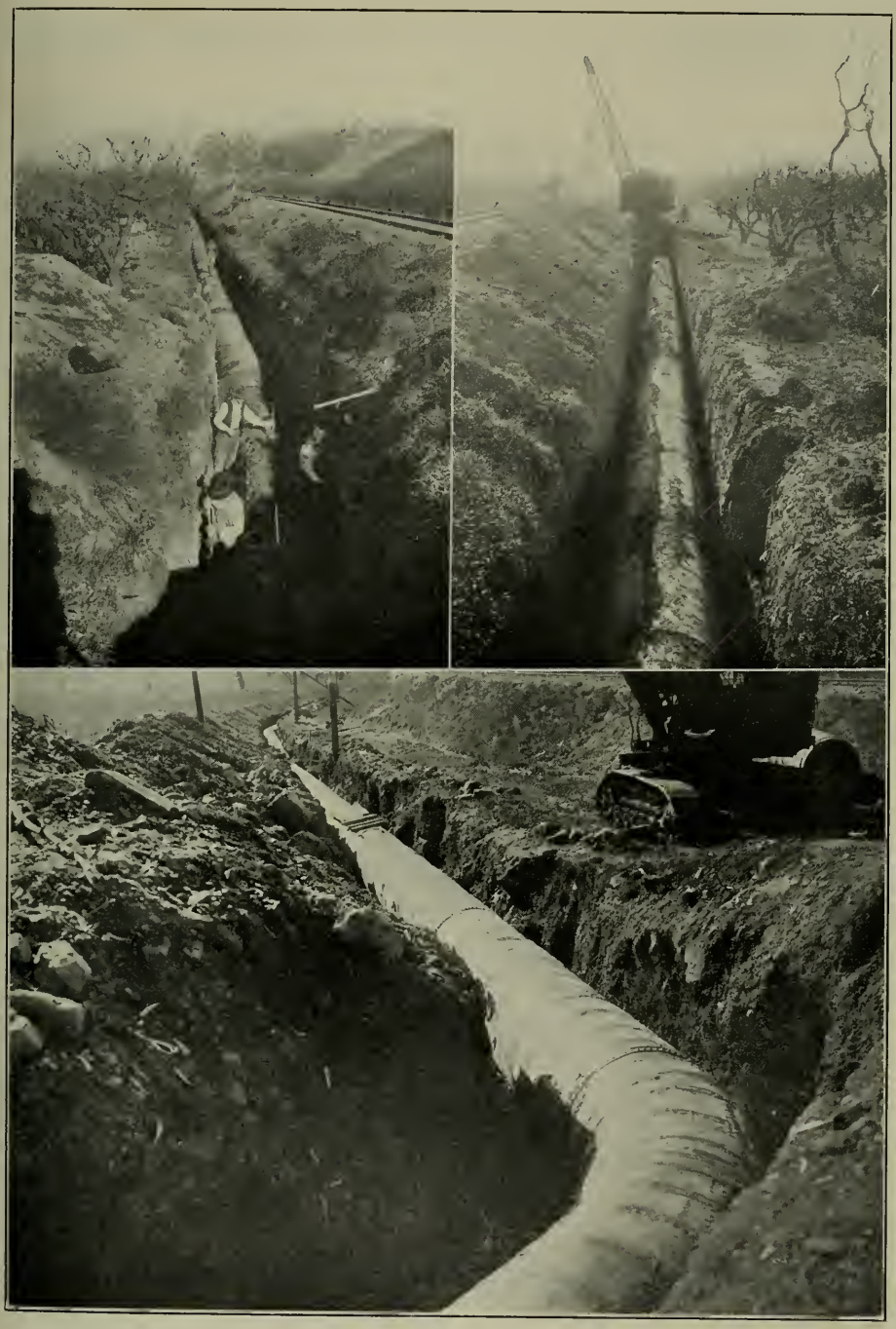
During the past few years the custom of wrapping the dipped pipe with a composition paper has become prevalent. It costs only a few cents a foot additional, but is well worth the expenditure as an insurance against the breaking off of the coating next to the metal. Experience in connection with some of the long steel pipe lines laid in the alkaline soils of the San Joaquin Valley, which have been dipped in asphaltum and wrapped, indicates that the wrapping is well worth while. Probably a description of the method of using this protective covering would be of interest:

After manufacture, the pipe is to be cleaned of dirt, scale and rust, and dipped in asphaltum at a temperature of 360° F. and is to remain in the kettle until the metal has attained the temperature of the bath. After the pipe has been dipped it is to be spirally wrapped with mica covering, wrapping to be put on under a tension of not less than fifty (50) pounds per eighteen (18) inches width of wrapping. The ends of the wrapping at the joint connections are to be finished off by sealing with hot asphaltum.

The mica covering shall be of felt, which has been thoroughly saturated with a high melting point bituminous compound, containing not less than twenty-five (25) per cent by weight of an alkali resisting mineral. The finished product shall weigh not less than three and six-tenths (3.6) pounds per square yard. Flaked mica shall be applied to the side of the coating which will be on the outside of the pipe, in such quantities as to give the best results.

A twelve (12) inch strip of the covering long enough to give a four (4) inch longitudinal lap is to be furnished with each section of pipe, together with the necessary asphaltum for wrapping and sealing the field joints.

It has been the experience of the writer that where plate metal pipes have been carefully coated with a satisfactory protective covering material, and then laid in ordinary well drained, light soils, it is not unreasonable to expect a life of from forty to fifty years.



THREE STRIKING VIEWS OF A 44-INCH LINE OF SOIL-PROOFED PIPE. *The pictures were taken on Spring Valley Water Co.'s new Niles-Irvington line.* UPPER LEFT—*Completing final tests.* UPPER RIGHT—*Backfilling trench. Lower picture shows field joints not yet wrapped.*

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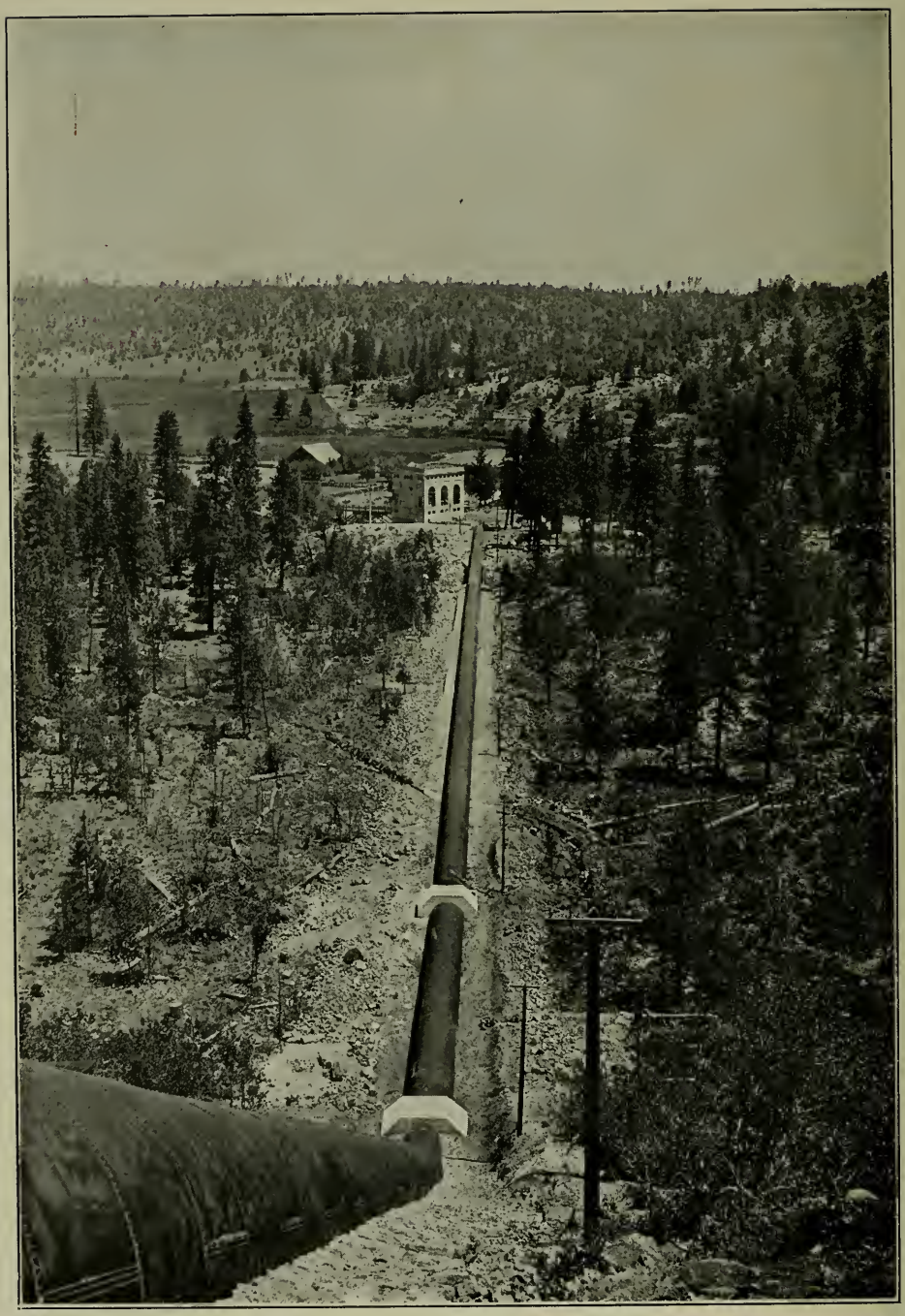

ON THE GREAT PIT RIVER DEVELOPMENT—*Looking down from the forebay, Pacific Gas & Electric Co.'s Hat Creek Power House No.* 1. *This Western Pipe & Steel penstock is* 1600 *feet long,* 10 *feet diameter at top and* 8 *feet at bottom. Head* 217 *feet.*

Western Pipe and Steel News

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SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME II MAY, 1925 NUMBER 5

An Outline of Western Hydro-Electric Development for N. E. L. A. Delegates

WESTERN Pipe & Steel Company takes pleasure in joining in California's welcome to the delegates to the convention of the National Electric Light Association at San Francisco. As Americans, we are proud of the splendid work that has been accomplished by this association in advancing the standards of a great industry.

As Californians, we are proud of our State's enormous contributions to hydro-electric development. It is not boasting, but plain statement of fact to say that California leads the world in the magnitude of its hydro-electric achievements, in engineering genius, and in the vision and resourcefulness of its leaders.

As manufacturers, we are proud of the part this company has played in hydro-electric development on the Pacific Coast. W. P. & S. has not only kept abreast of this development but has had the honor of executing work on many of the gigantic projects involving radical departures, for which the hydro-electric companies of the Pacific Coast are famous.

This number of *W. P. & S. News* is not only dedicated to the N. E. L. A. Convention as a complimentary gesture to a great and progressive industry, but is devoted to giving, in terms necessarily epitomized, a record of what the electric companies of the Pacific Coast are contributing to the industry. We purpose further to outline with due modesty the part played by W. P. &. S., as we believe others will be interested in knowing what manufacturing facilities are back of the gigantic hydro-electric projects on this Coast.

Few people realize that hydro-electric development on the Pacific Coast had its inception so recently as 1889. The first hydro- electric plant in this region was built in that year. In 1924 electric consumers on the Pacific Coast spent in round numbers $110,000,000 for more than 7,100,000,000 kilowatt hours, and hydro-electric power now ranks as one of the leading commodities. Between that puny plant of 1889 and today's huge generating stations and far-flung transmission lines lies the most remarkable story of electrical development the world has ever known. This story is rich with examples of ingenuity, initiative and indomitable will which time and again have broken all records, so that the engineering world now watches with interest to see what the West will do next, so firmly is leadership established here.

Before proceeding to outline the magnitude of the various companies, it may be well to summarize the resources of the Pacific Coast. Briefly, the hydro-electric resources of California, Oregon and Washington make up 43%

of the total potential water power of the United States. These three states with scientific development can produce every year 104 billion kilowatt hours. At present, 10% of this is developed. If the other 90% were utilized, this region would produce enough hydro-electric energy to supply a population of more than 23,000,000, on a consumption basis of 5000 kilowatt hours per person. The present population of the three states is approximately 7,000,000. As to how rapidly the resources of this region will be developed, the best authorities estimate that in California alone $500,000,000 will have been spent in hydro-electric construction in the decade ending in 1935.

The Pacific Gas & Electric Company with headquarters at San Francisco has the largest hydro-electric system in the West. It has nearly 3,500 circuit miles of transmission at voltages ranging between 30 kv. and 220 kv. fed by 474,550 k. w. of plant capacity. The company serves nearly 350,000 electric consumers scattered over 54,000 square miles. (Note—the total area of California is 158,297 square miles. The Pacific Gas & Electric Company alone serves a territory more than eleven times the size of Connecticut). It operates 23 hydro-electric generating plants with a total capacity of 1,296,505,218 k. w. hours.

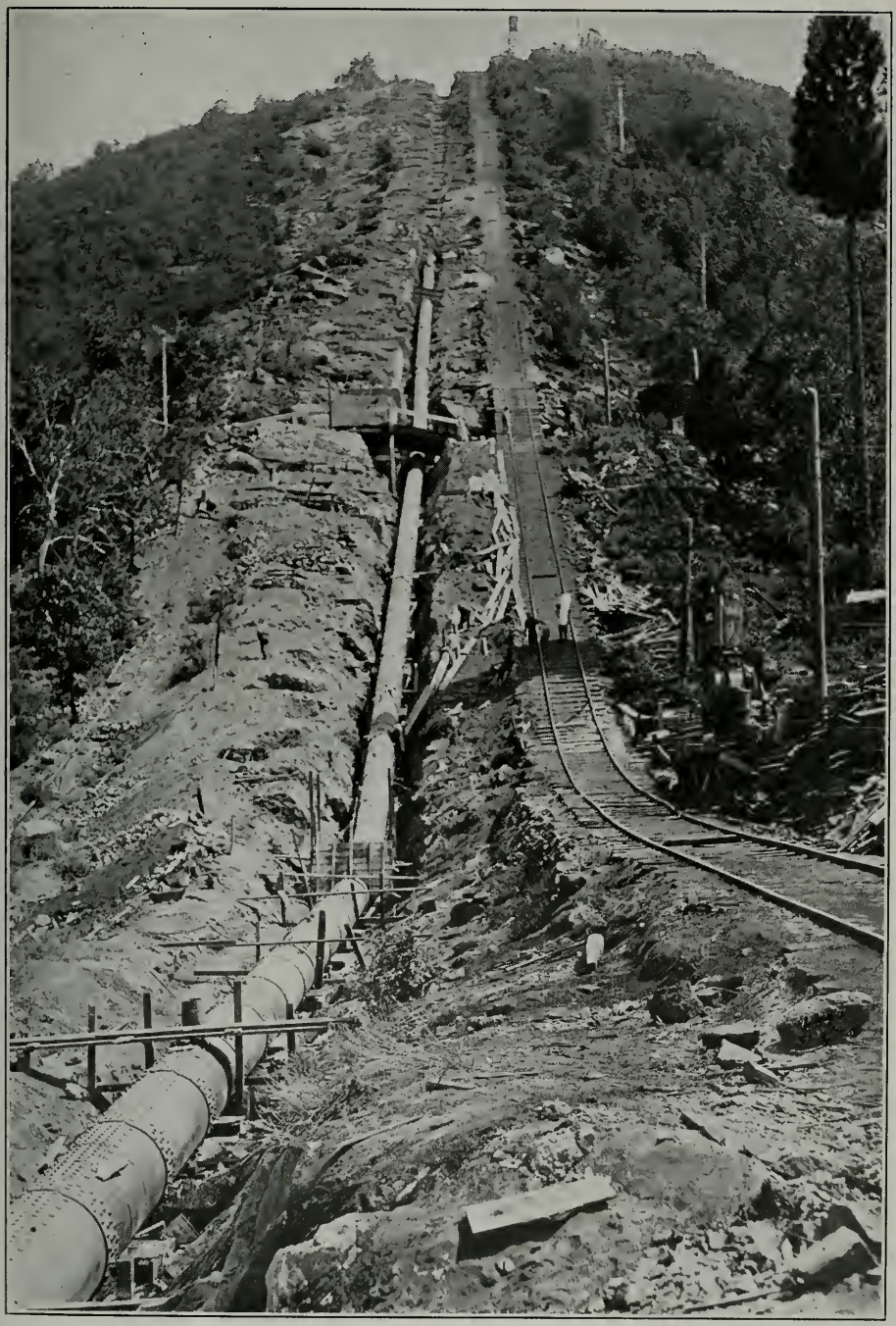
W. P. & S. has fabricated upwards of 6,000 tons of steel penstock pipe for the Pacific Gas & Electric Company during the past decade. Among the contracts may be mentioned:

Penstock for Drum Power House, located in Bear River Gorge in the Sierra Nevadas, 6,272 feet long, weight nearly 3,000,000 pounds, diameter 72 inches at intake and 52 inches at the power house, maximum head 1,375 feet. Stanislaus plant penstock, 3,038 feet long, weight 1,113,924 pounds, diameter 49½ inches at intake and 40 inches at power house. Penstock for Hat Creek power plant No. 1 (Pit River development), length, 1,600 feet, diameter at intake 120 inches, diameter at power house 96 inches, head 217 feet. Other P. G. & E. installations with which W. P. & S. has been identified include the Halsey development near Clipper Gap, the Spring Gap development on the middle fork of the Stanislaus River, and Hat Creek No. 2. W. P. & S. has also furnished P. G. & E. with many other items, including welded pipe for gas mains, riveted steel water pipe, gas holders, gas generating equipment, steel tanks and special plate work.

One of the largest power companies in the West is the Southern California Edison Company with headquarters in Los Angeles. This company serves a territory of 55,000 square miles with a population of over 2,200,000. It has 2,272 circuit miles at voltages of from 30 kv. to 220 kv. supplied by 497,800 k. w. of installed plant capacity. The Edison company, which covers ten counties and serves 360 cities and towns, operates 20 hydro-electric plants. The annual hydro-electric output according to latest available figures was 1,136,354,963 k. w. hours. The total generating capacity of the company is now more than 500,000 H. P., while at Big Creek alone there is in the neighborhood of 200,000 H. P. yet to be developed.

The Edison company has recently completed the Florence Lake tunnel which ranks as one of the greatest achievements in the history of hydro-electric development. It is in the high Sierras, northeast of Fresno and is 13½ miles long, 15 feet in diameter and pierces the base of Kaiser mountain. It diverts the upper waters of the San Joaquin River about 45 miles from their natural course into Huntington Lake. The additional water to be stored in Huntington Lake by means of this tunnel will generate 1,250,000,000 K. W. H. per year or sufficient power, if devoted entirely to industry, to empower 5,100 factories employing 200,000 people.

(Continued on page 4)



A SOUTHERN CALIFORNIA EDISON PENSTOCK.—*Western Pipe & Steel fabricated this huge penstock for Big Creek Power Plant Number 2. The heavy pipe sections were loaded on flat cars and pulled up the incline by cable.*

W. P. & S. has played a considerable part in the development of Southern California Edison Company. It fabricated penstock for the Edison Company's Big Creek Plant No. 2 and has supplied many riveted pipe lines and other material, including a wide variety of plate work. A full page illustration in this issue shows the installation of W. P. & S. penstock for Big Creek Power Plant No. 2.

Another of the major companies is the San Joaquin Light & Power Corporation, the history of which is interwoven with the building of California's great inland empire—the San Joaquin Valley. The company now operates eleven hydro-electric plants and three steam plants, generating nearly 190,000 H. P. It plans to develop on Kings River an additional 495,000 H. P. This project will be spectacular even for California, because of the high altitude of storage and the unusual highhead under which the plants will operate.

Balch plant, the first unit upon which construction has been started, will have a static head of 2,470 feet, the highest in America. This plant will cost nearly $5,000,000 and will be brought in on the line January 1st, 1927.

The company serves territory with a population of 400,000 and covers 147 cities and towns. In this territory there are more farm homes lighted by electricity than in any other agricultural district of equal size in the world.

The company's largest generating unit is the Kerckhoff plant on the San Joaquin river, 45 miles from Fresno. Its generating capacity is 56,800 H. P.

W. P. & S. played an important part in the construction of the Kerckhoff plant. The picture reproduced on the cover of this magazine shows the 3-line steel penstock fabricated by this company. These lines range in length from 928 to 972 feet. Their diameter at the top is 96 inches, at the power house 84 inches. The steel plates at the upper end are 5/16" in thickness and range to 11/16" at the bottom. Three batteries of three 6-inch W. P. & S. air valves are in each line. At the Midway steam plant, many hundreds of feet of W. P. & S. products were used. The suction line is 48" in diameter and the discharge line 36". W. P. & S. well casing is used in six 12-inch wells, 500 feet deep which supply 25,000 gallons per minute. In addition to these plants, W. P. & S. has supplied much other equipment for the San Joaquin Light & Power Corporation.

The Great Western Power Company is another of the major companies of California. Its headquarters are at San Francisco and it has long been an important factor in the progressive development of the water resources of the West. It serves a large territory in Central California, and the cities of Sacramento, Oakland and San Francisco. The population of this ter-

Western States Gas & Electric Co.'s Alder Creek Syphon, near Placerville. Fabricated and installed by W. P. & S.

ritory is 1,400,000 and it has nearly 50,000 consumers of electricity. The Great Western has two 110,000 volt circuits reaching from Big Bend on the Feather River to Oakland, a distance of 154 miles. It has one 165,000 volt circuit reaching 200 miles from Caribou to Golden Gate sub-station. The company, according to latest available figures, has reached an annual total output of 575,000,000 k. w. h. of water-generated energy. It has installed capacity (hydro) of 110,400 k. w. and is constructing plants with an additional 22,000 k. w.

W. P. & S. has fabricated a great deal of equipment for Great Western Power, particularly in general plate work.

An important hydro-electric project in California is that of the City and County of San Francisco in connection with its great Hetch Hetchy water supply project.

For the Moccasin Creek Power plant, which has a 24-hour continuous capacity of 52,500 k. w., W. P. & S. fabricated some of the largest penstock work ever undertaken. The pipes are 104" in diameter initially, reducing in size until at the power house they are 54" in diameter with plates 1-5/16 inches thick. The slope length of the penstock line is 6,025 feet. In the foothill division of the Hetch Hetchy, W. P. & S. fabricated the steel pipe known as Red Mountain Bar Syphon, 770 feet long, under the Dom Pedro reservoir on the Tuolumne River. The pipe is 9 feet 6 inches in diameter and the steel plates 9/16" to ¾" thick. On the Bay Crossing division, W. P. & S. fabricated a steel pipe line 60" in diameter and 19.4 miles long. This work alone required over 17,000 tons of steel.

Another great municipality that is an important factor in the hydro-electric field, is the City of Los Angeles, which generates 242,787,000 k. w. h., all hydro generated.

An important unit in the city's system is power plant No. 2 in San Francisquita Canyon. The penstock for this plant was fabricated by W. P. & S.

The California-Oregon Power Company is another important link in the West's great chain of power companies. It now has eight hydro-electric power plants with an annual output of 133,700,000 k. w. h. It serves 44 thriving communities of Southern Oregon and Northern California.

W. P. & S. has fabricated for this company two of the largest penstocks on record, 14 feet in diameter. It has also constructed differential surge tanks and a general line of plate work for this rapidly growing concern.

Another important company in Central California is the Western States Gas & Electric Company, *for which W. P. & S. fabricated the famous Alder Creek Syphon near Placerville.* The annual output of its hydro-electric equipment is approximately 30,000,000 k. w. h. and it numbers more than 35,000 consumers.

The Southern Sierras Power Company and associated companies, *for which W. P. & S. has done a great deal of work,* supply electricity to practically the entire territory lying east of the Sierra Nevada and south to the Mexican border. They also supply some power in Nevada and Arizona and deliver at the border for resale into Mexico. These companies in 1924, because of the unprecedented drouth and resultant power shortage, found it necessary to quickly construct three additional hydro-electric plants, totaling 25,000 H. P. The construction of these plants required the use of 2,300,000 pounds of large high-pressure steel pipe and it was only through the cooperation of the pipe manufacturers that they were able to complete the plants in time to materially relieve the power shortage. One 7,500 H. P. plant was completed in the remarkable time of 7 months. The substitution of large steel pipe for tunnels made this possible.

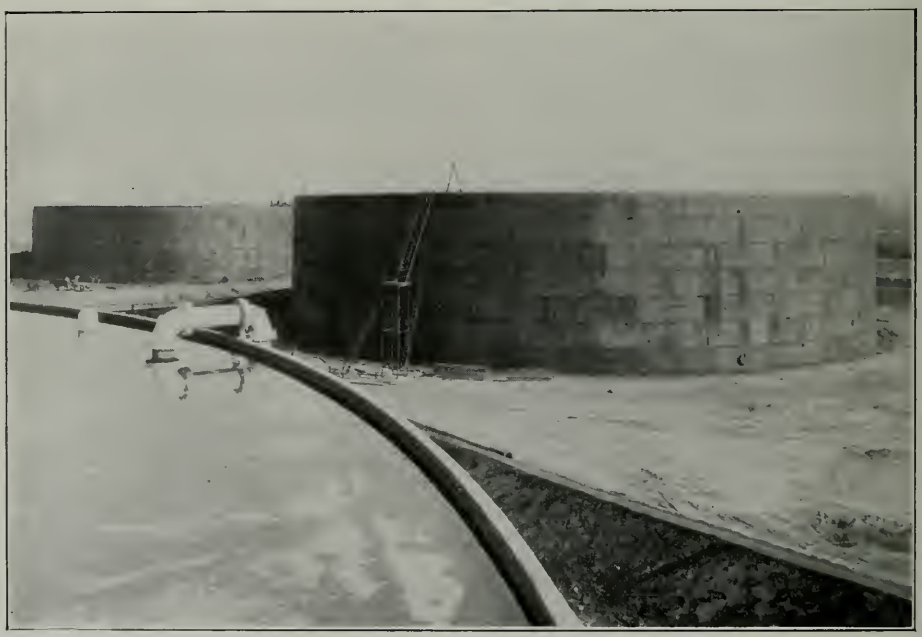
Oil Industry Highlights

WITH two of the greatest, and *the* two most spectacular industries in California, Western Pipe & Steel has been privileged to grow up from small beginnings. Hydro-electricity is one of these—oil is the other. For the oil industry we have pioneered new paths in producing equipment and accessories. One of the greatest of our contributions was the fabrication and erection of the world's largest oil storage tanks—178,000 barrels capacity—six of which we built for the Associated Oil Co.

Five were erected at the Company's Watson tank farm, near Los Angeles, and the sixth at Avon, in Contra Costa county, last year.

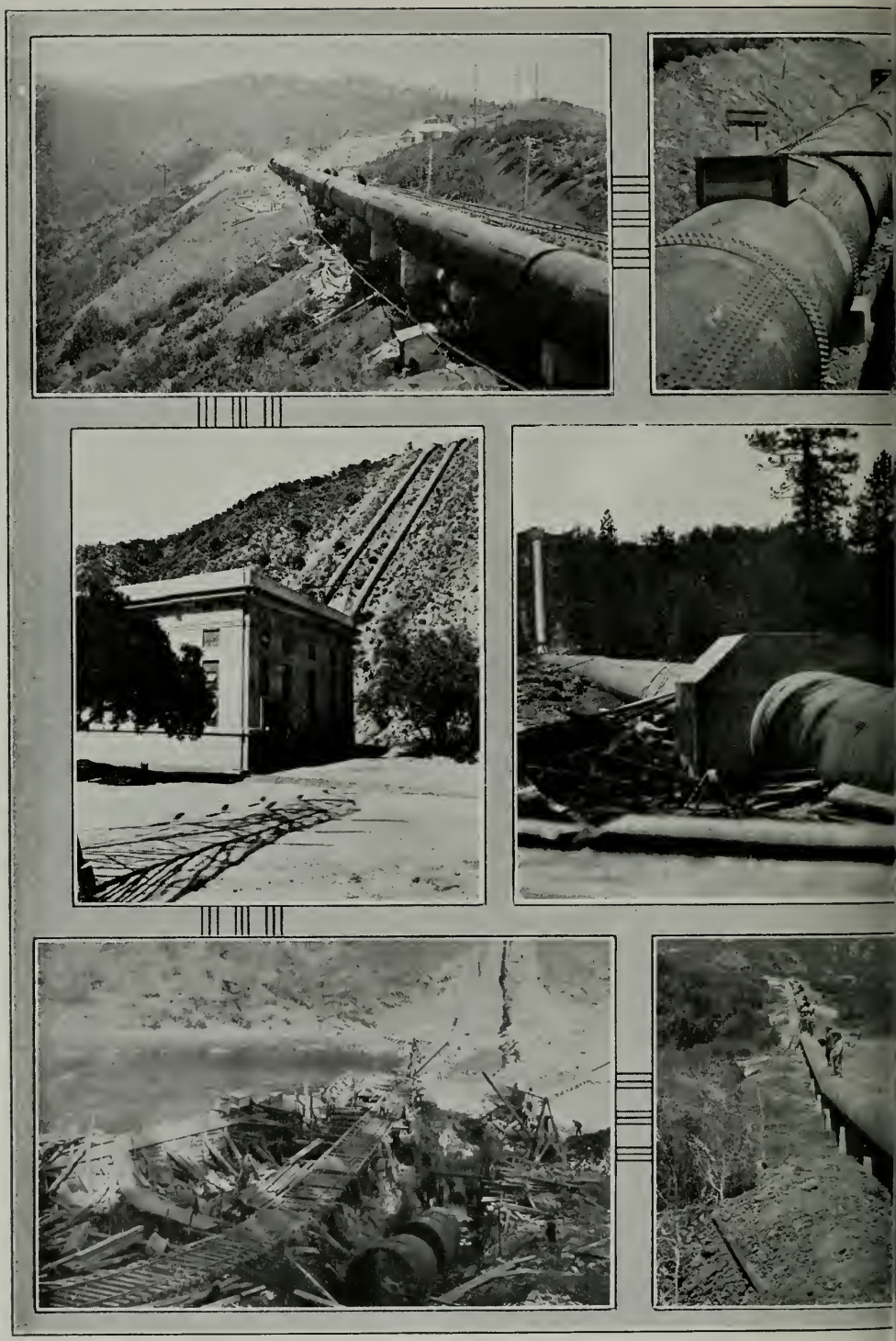
Another W. P. & S. contribution is the development of oil well casing, illustrated on the opposite page and telling its own story. Again, we introduced the bolted steel tank to the California oil industry; we are the only Western manufacturers who specialize in it. It was originated because the industry demanded a tank that could be transported quickly to the spot where needed, erected with dispatch, and when necessary, could be taken apart, moved and re-erected easily and cheaply. The credit goes to our engineering department.

Adaptation of autogenous welding to replace oil storage tank bottoms was also worked out by our engineers. Where it was formerly thought necessary to tear down a tank completely to replace the bottom plates, W. P. & S. developed a plan of working through a door sheet, cutting out the old bottom plates and welding in new ones. This process saves thousands of dollars on a large tank, and exemplifies progressive engineering methods.



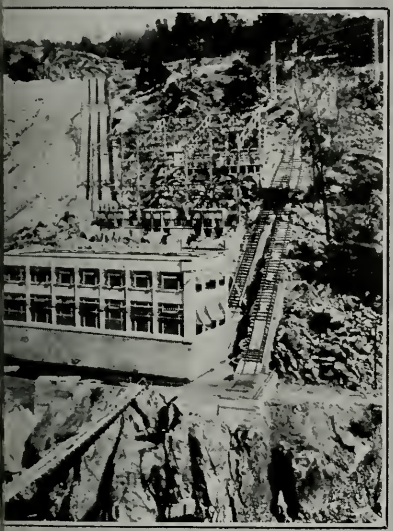
The world's largest oil storage tanks—178,000 barrels—fabricated and erected by W. P. & S. for Associated Oil Co. at Watson Tank Farm.

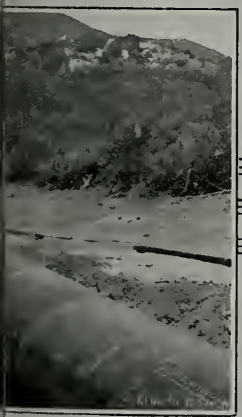
SETTING CASING IN A CALIFORNIA OIL FIELD.— *This W. P. & S. field crew broke a record when they landed and cemented 1260 feet of 16-inch casing in ten hours 35 minutes. The well is one of E. J. Miley's, in Athens Field, near Los Angeles.*



SOME EXAMPLES OF PENSTOCKS AND SYPHONS FABRICATED B

tion of penstock for Moccasin Creek power plant of San Francisco's Hetch Hetchy p
Francisquita power plant No. 2.—Close-up of penstock of Pacific Gas & Electric Co.'s
lation of fourteen foot penstock for California Oregon Power Co., Klamath Falls. B
Two views taken during installation of San Diego Water Co.'s famous Hell Hole Syph





N PIPE & STEEL COMPANY—Top: *Three progress pictures taken during installa-*
ER *(left to right): W. P. & S. penstock after installation at City of Los Angeles San*
wer plant No. 1.—San Joaquin Light & Power Corporation's Kerckhoff plant.—Instal-
o right): City of San Francisco's Red Mountain Bar Syphon, Hetch Hetchy project.

Western Pipe and Steel News
PUBLISHED BY
WESTERN PIPE AND STEEL COMPANY
of California
444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

ON BEHALF of our customers and friends—and we feel that the terms are synonymous—we take pleasure in dedicating this number to the thousands of delegates attending the annual convention of the National Electric Light Association at San Francisco from June 15 to 19.

Our purpose is twofold: to enlighten the men coming from the East and Middle West regarding the marvelous achievements of this region in hydro-electric development; and to show them what kind of manufacturing facilities are behind the men who are doing these big things.

The bold spirits, the ingenious brains, the keen visioned engineers, the empire-building financiers who pioneered—and developed—hydro-electricity, have been men of the West.

We felicitate the delegates to the N. E. L. A. They come to the land of big things, to see for themselves.

They come to a State which shows the highest annual per capita consumption of electrical energy in the United States—1,300 kilowatt hours, (the average for the whole country is 500), and which uses over 17 per cent of its electrical energy for agriculture.

California is the Electrical Promised Land. Members of the N. E. L. A., we bid you welcome.

These huge twin penstocks for the Moccasin Creek Power House of the City of San Francisco—104" diameter—were made by W. P. & S.

A Broad Manufacturing Field

WESTERN Pipe & Steel has probably as broad a range in the manufacturing field as any concern of its type in America. In this number, which is devoted especially to the exploitation of products supplied to public utilities and municipalities, some of our lines are necessarily subordinated, not because they are unimportant, but because in limited space the more spectacular "big" work must be featured. We would not, however, be giving our readers a fair outline of our work if we did not draw attention to certain products.

Welded pipe, for instance, we have manufactured for years, not only for gas mains, but for water lines as well, and our facilities are now unexcelled, perhaps are not equalled, for this work. Both the Los Angeles and San Francisco plants are turning out welded pipe of the same high quality that marks other W. P. & S. products.

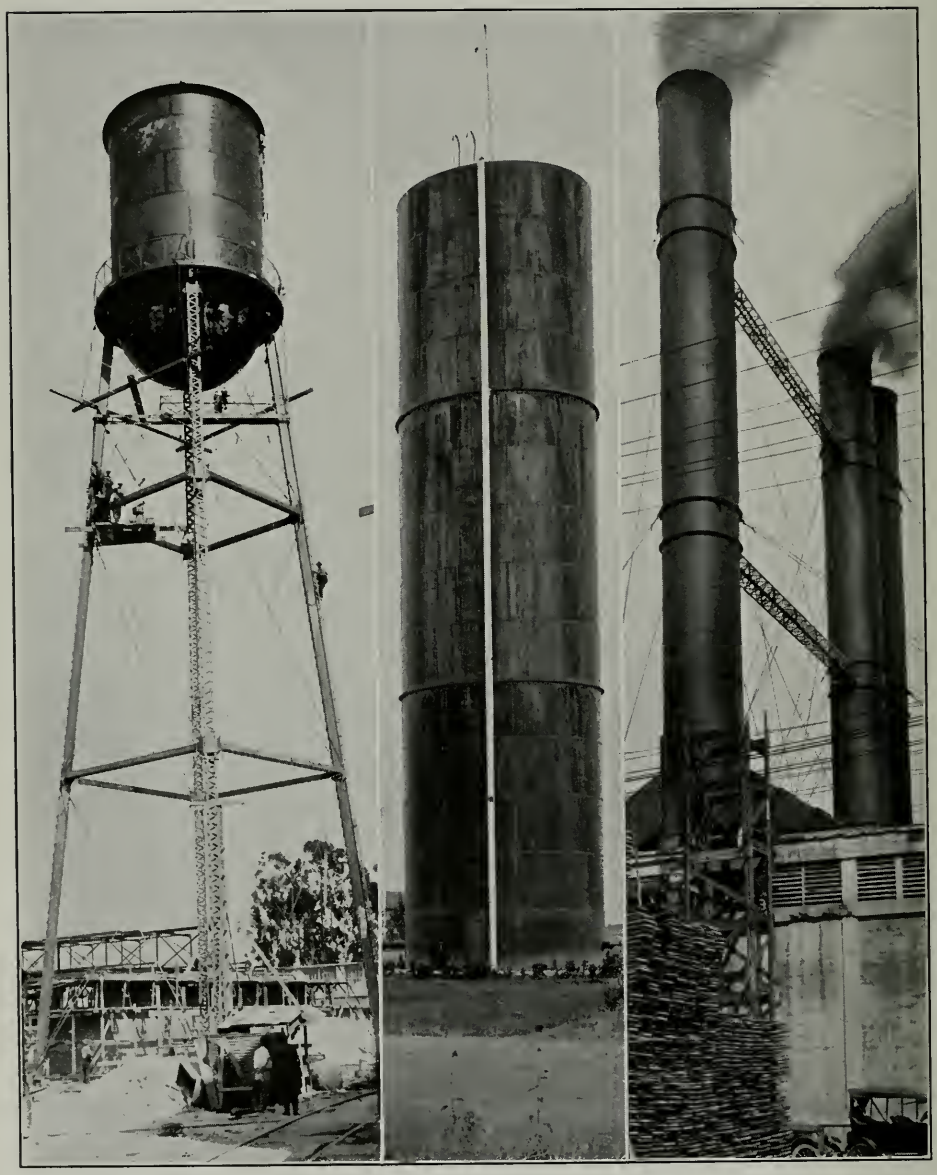
Another line for special mention is gas holders. We not only fabricate and erect gas holders of every size, including the largest, but we are specially equipped for tearing down gas holders for re-erection or removal. We have performed this service for some of the largest utility companies in California.

A specialty that we turn out in large quantities is the hemispherical-bottom riveted steel water tank on steel tower, as illustrated on the following page. These are made in any size or height, and the best manufacturing skill goes into them.

Steel standpipes and smokestacks, also illustrated herein are other specialty lines of which we can refer to many noteworthy examples throughout California. We not only fabricate and erect such work, but design it as well. The services of our engineering department are always available in the planning of these, as well as all other sheet and plate work.

A close-up of automatic electric-welded pipe as turned out in the shops of W. P. & S.

Tower Tanks—Standpipes—Smokestacks



Three striking examples of the wide variety of W. P. & S. products. A 75,000-gallon hemispherical-bottom riveted steel tank on 100-foot steel tower. Fabricated and erected for West Coast Porcelain Manufacturers at Millbrae, Calif.—A steel standpipe, 15 feet in diameter and 70 feet high, for the San Joaquin Valley Farm Lands, San Joaquin, Calif.—A trinity of steel smokestacks, 8 feet by 100 feet, for Great Western Power Co. at San Francisco.

Gas Holders—Large and Small

Some of the largest, as well as some of the smallest, gas holders in California have been designed, fabricated and erected by W. P. & S. Upper picture was taken at Visalia, Calif., where this 200,000 cubic foot gas holder, together with generator, scrubbers and washbox, was a W. P. & S. contract for Central Counties Gas Co. The lower picture of a baby gas holder of 12,000 cubic feet capacity was taken at Los Angeles at the plant of the Western Oxygen Co.

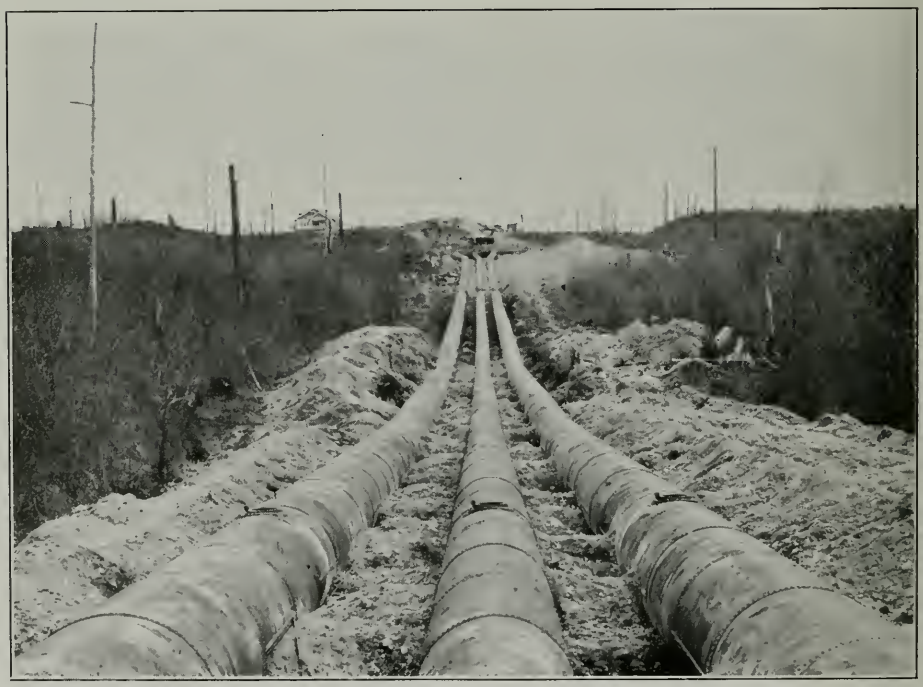
Some Notable Water Pipe Lines

IT GOES without saying that water has played a most important role in the development and progress of the Pacific Coast. Wherever there is water development, there, of course, is a call for the fabrication and installation of steel pipe on a large scale. A fair picture of what has been done may be obtained from a brief review of the activities of Western Pipe & Steel in this field of manufacture, in which it has been a leading factor for many decades.

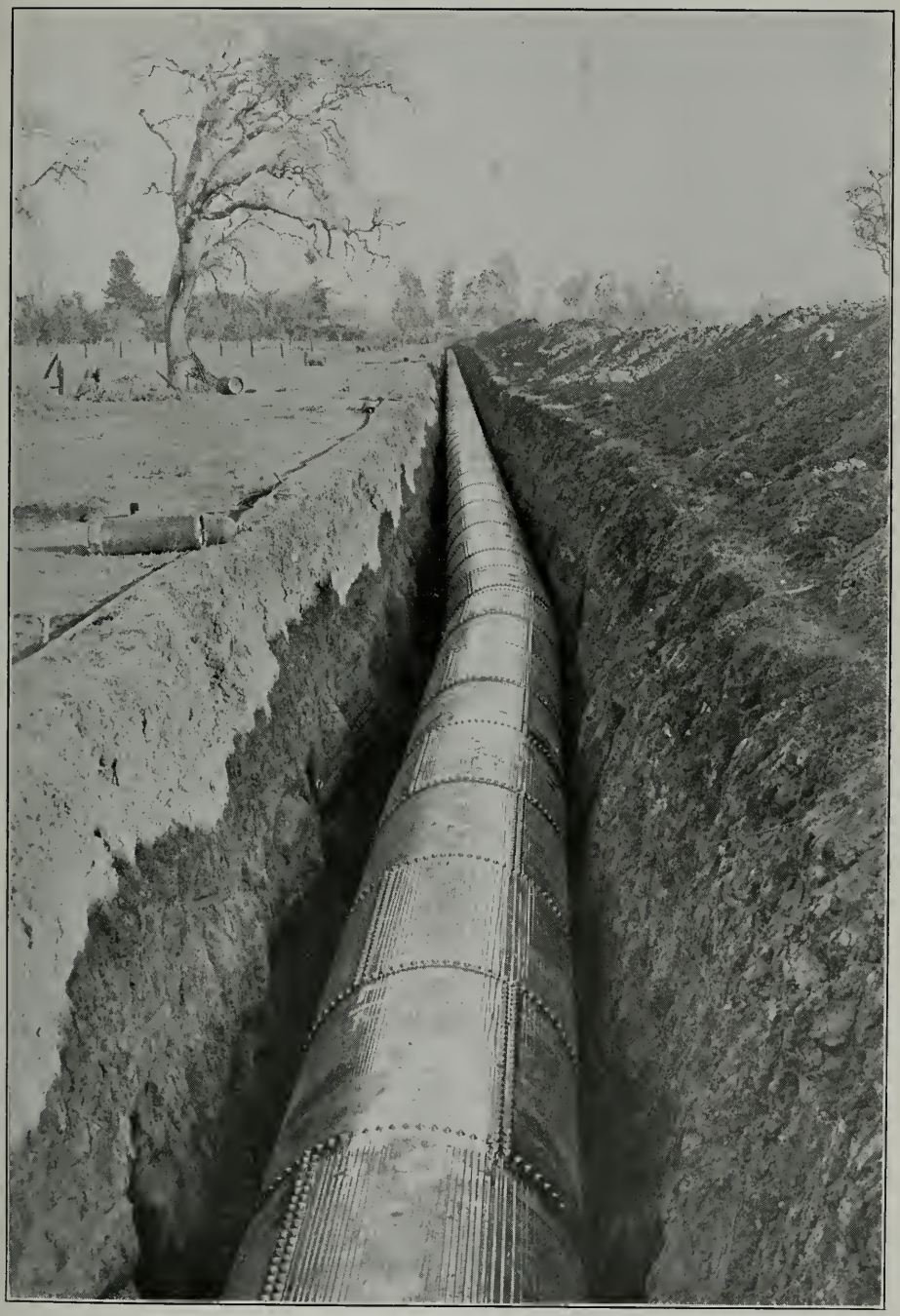
The City of Los Angeles has 400 miles of riveted steel pipe in its distributing system, a large portion of which was fabricated by Western Pipe & Steel in its Los Angeles plant. Other Southern California cities where this company has had large pipe orders are San Diego, San Bernardino, Riverside, Santa Monica, Beverly Hills, Redlands, Ontario and many others.

In San Francisco and its vicinity some of the major work executed includes 19.4 miles of 60-inch riveted steel water pipe for the Bay Crossing Division of the city's Hetch Hetchy project, one of the largest contracts on record; miles of soil-proofed riveted steel pipe for Spring Valley Water Co.; and a pipe line for the City of Menlo Park. Across the bay much pipe has been furnished the Eastbay Water Co.

The cities of Seattle and Everett, Wash.; Santa Cruz, Sacramento, Fresno, San Jose and Vallejo are other municipalities where this company has been engaged to supply pipe, either for the municipality or for its water company.

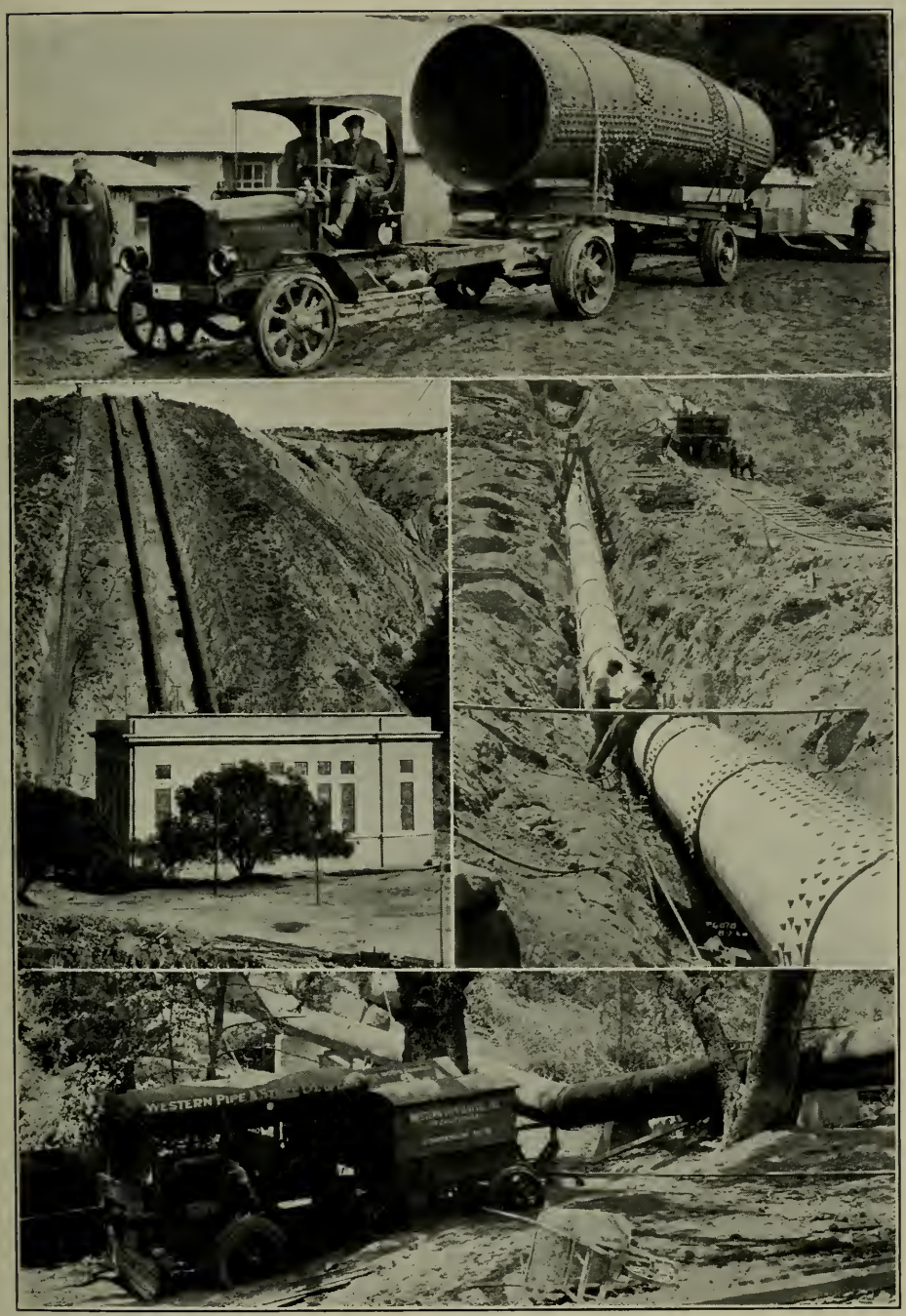


A triple line of riveted steel pipe manufactured by W. P. & S. for the City of Seattle's Lake Youngs water supply project.



VIEW ALONG SAN FRANCISCO'S 20-MILE PIPE LINE.—*This shows some of the 60-inch riveted steel pipe fabricated and installed by W. P. & S. for the Bay Crossing Division of the Hetch Hetchy project. Picture taken near Redwood City, 30 miles south of San Francisco.*

A 36-INCH WATER MAIN IN THE HEART OF LOS ANGELES.—*This important link in the distributing system of the southern metropolis follows the west bank of the Los Angeles River. Many miles of this riveted steel pipe were furnished by W. P. & S.*



HEAVY PLATE WORK FABRICATION—*Upper—A section of penstock on its way to City of Los Angeles San Francisquita Canyon Power Plant No. 2. Left—View of power house, showing penstock after installation. Right—Installation of a heavy penstock manufactured by W. P. & S. for Southern California Edison Co. Lower—The bottom of the famous Hell Hole syphon of the San Diego County Water Co.*

In the West It's "Western"

TO ACHIEVE and maintain success all industries must consistently and conspicuously deserve it.

The highest form of manufacturing success is attained when a concern becomes so proficient in its field that it is selected, usually without debate, to solve the difficult problems, to perform the exacting tasks.

This company has been repeatedly so honored. The part it has been called upon to play in the hydro-electric development of the West sufficiently testifies to its reputation and standing as a manufacturer.

Western Pipe & Steel purposes to maintain the success it has achieved by strict adherence to the principles and policies that have always governed it.

Western Pipe & Steel Co.

of CALIFORNIA

444 MARKET ST.
SAN FRANCISCO

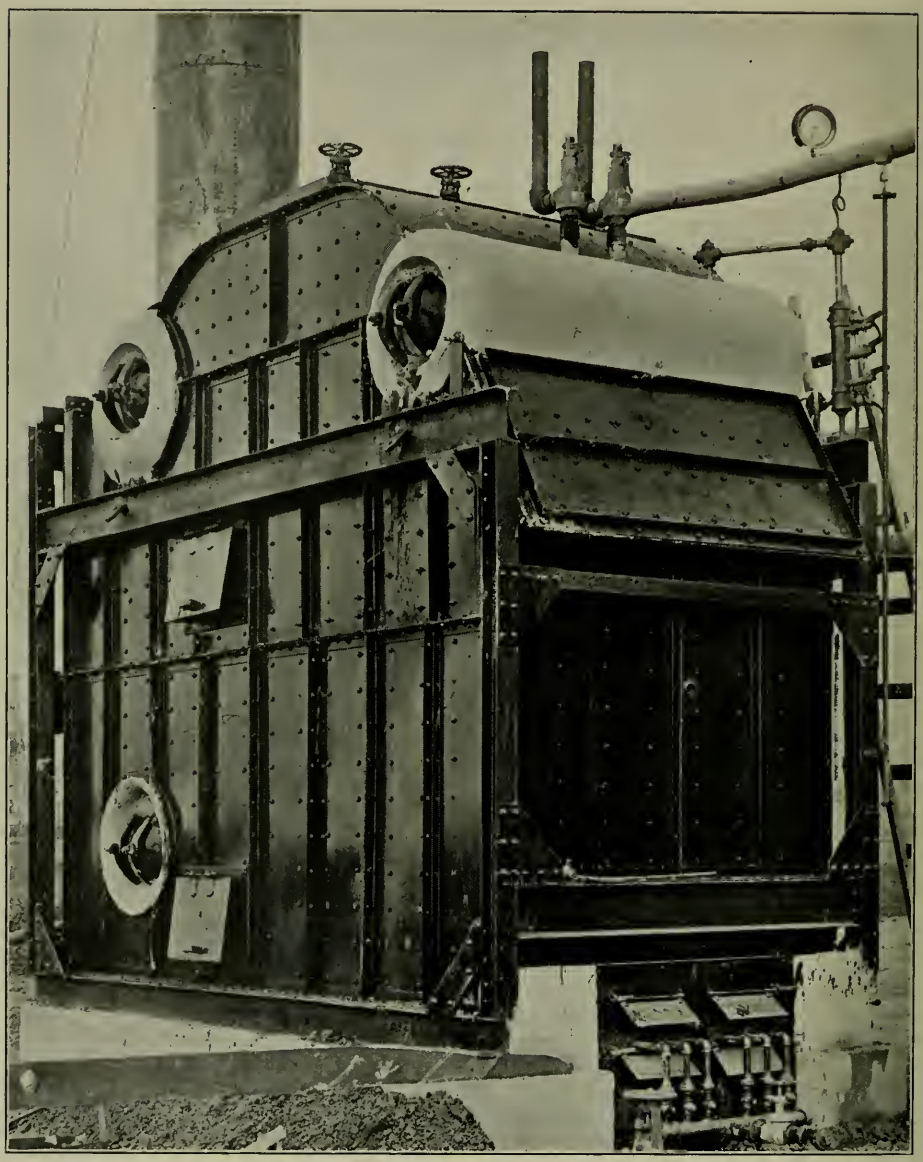
5717 SANTA FE AVE.
LOS ANGELES

FACTORIES

SOUTH SAN FRANCISCO · LOS ANGELES · FRESNO · TAFT · PHOENIX

Designers · Fabricators · Erectors of General Plate Work

WESTERN PIPE AND STEEL NEWS



AN 80 H. P. PORTABLE TYPE SOUTHWESTERN COLLINS WATER TUBE BOILER IN ATHENS FIELD—*Two were installed by Producers' Gasoline Co. at their No. 1 plant. There are three like this at their No. 2 plant. In the six months since January 1st installations of Collins boilers have been made for Shell Co. of California, Western Refining Co. (two 265 H. P.), California Gasoline Co. and others. Contracts under way or in hand include two 250 H. P. for Story Building, Los Angeles; two 200 H. P. for new Lutheran Hospital; one 345 H. P. for Hall of Records, Los Angeles; two 212 H. P., Foster Oil Company; one 268 H. P., Mendocino State Hospital. Boilers for numerous other installations are in process of fabrication at W. P. & S. plant.*

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WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME II JUNE-JULY, 1925 NUMBER 6

The Southwestern Collins Safety Water Tube Boiler

NO truer aphorism has ever been coined than that which says, "To keep abreast of the times one must progress," and there are not many better examples of the truth of this than the Southwestern Engineering Corporation which recognized the value of a new idea and in conjunction with G. A. Collins, Mechanical and Mining Engineer, has developed the Southwestern Collins Safety Water Tube Boiler.

This boiler is believed by many to be the most efficient ever designed. Southwestern Collins boilers in various types are being manufactured in rapidly increasing quantities by Western Pipe & Steel Company of California and are marketed by Southwestern Engineering Corporation of Los Angeles.

Readers of what follows who are "boiler men," and familiar with the Stirling, the Badenhausen, the Kidwell, the McAleenan and others, will see at once a similarity between these well-known types and the Southwestern Collins boiler. Being "boiler men" however, they will study the cuts which illustrate this article and in doing so will see that their first impression is far from being correct, for there are very marked differences.

It is remarkable that until now no one of the brilliant designers of boilers has hit upon the obviously practical idea of using a staybolted water leg to receive one or two of the main banks of tubes in what are now generally spoken of as "bent tube boilers." Having "one wheel, so to say, in the groove of bent tubes entering a drum," it was too big a wrench to their mental processes to grasp the fact that bent tubes can be more advantageously expanded in a box construction.

In the Southwestern Collins Type B boiler the two main banks of tubes are arranged thus, and in this manner produce first, a symmetrical figure that affords the nearest approach to ring circulation that any design of practical value has so far attained. Having secured this most desirable feature of ring circulation, the next thing is to take off the steam generated at tangents so that the water circulation will continue unrestricted by steam bubbles.

Fig. 1 illustrates the 80 H. P. portable type Collins boiler. In the triangle of tube banks, the main bank over the furnace is marked A, that marked B is the secondary, C is the downcomer bank, while D designates the overcomer bank. In the following paragraphs, the action in each of these banks is described.

Since A is subjected to the greatest quantity of heat, it will generate approximately 70% of all the steam made by the boiler, and owing to the sharp inclination of the tubes the steam will be rapidly discharged into the water leg whence

it will travel, obeying the laws of centrifugal force, "at a tangent to the ring circulation" and on up into the front drum. From the front drum, steam and steam only will pass through bank D into the rear drum.

Now, note that in doing so, this 70% of all the steam generated has three distinct opportunities to get rid of any entrained water:

(1) After passing the baffle it must flow at an angle upward towards the rear so that moisture will drain back into the drum.

(2) In discharging into the rear drum the steam has a downward direction so that if any water should have been carried that far it would inevitably be added, by both its weight and velocity, to the water in the drum.

(3) The overcomer tube bank D, is located in the path of the hottest gases available from bank A and so 70% of the steam must be superheated, the degree of superheat attained depending on the rate at which the boiler is being operated.

In tube bank B, the remaining 30% of steam is made, but under more favorable conditions than in any of the earlier designs of bent tube boilers because in this case, there is no interference from the steam made in bank A. Again, since the heat of the gases has been modified by contact with tube banks A and D, the steam in bank B will be generated gently and there will be no tendency to spouting or geysering in the rear drum.

The net result is that approximately 30% of dry saturated steam is mixed in the rear upper drum with the remaining 70% of superheated steam and the boiler will furnish dry steam,

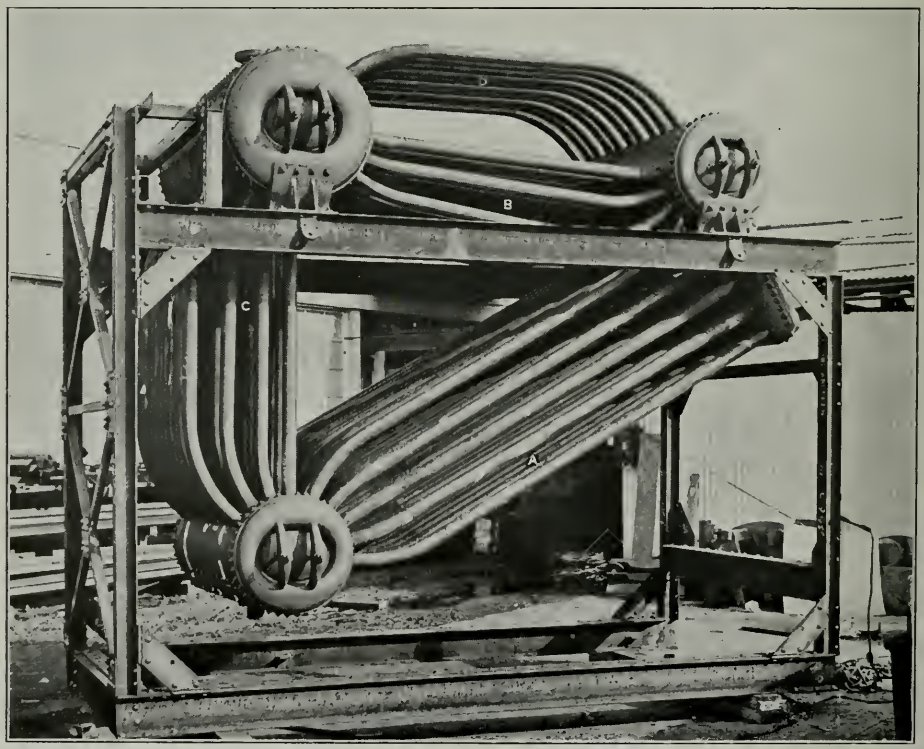


Fig. 1—*80 H. P. Portable Type Collins Boiler, showing suspension. The letters designate the circulation as described in the accompanying article.*

which is the most desirable product of any boiler, with the added advantage of some superheat, varying with the rate of operation.

The rear tube bank or downcomer tubes serve to convey the water from the upper rear drum where the feed water enters, to the lower rear or mud-drum. Since these tubes are located in the path of the coolest gases as they sweep towards the stack, the water will be heated to a temperature at which a large part of its solids in solution will be precipitated and, coming partially to rest in the mud-drum, will largely be deposited there.

The action of tube bank D has already been described under the paragraph dealing with bank A.

A boiler to be economical, must not only make plenty of dry steam but it must be capable of quick cleaning and quick return to the line. Herein lies a notable advance in the Collins boiler. By reason of the water leg the main bank can be cleaned as soon as the boiler has been blown down and it is not necessary to wait from 15 to 24 hours until the brickwork cools and incidentally bakes the scale on the tubes. Opposite each tube in the water leg is a Key cap which can be knocked in by a tap from a wooden maul. The cleaning by turbine of the main bank A of tubes can be commenced while the brickwork is still hot. Those who have had to turbine the tubes of water-tube boilers in the cramped position entailed by having to enter the still hot drums, will appreciate the godsend this construction affords. It stands to reason that a man will do more and better work if he can stand upright and move freely than he will do in the discomfort attendant upon working cramped up inside a hot boiler drum.

The many varying conditions that must be met as to floor space occupied, head room necessary, limits of pressure applicable to the design and so on, make it essential that the modern boiler be readily adaptable to meet them all.

In this respect the Collins boiler more fully meets all possible variations than any type so far developed. Thus, by merely increasing the width of the drums and water leg, the horsepower can be increased to almost any desired point. If the head room be restricted, large combustion space can still be retained by giving the water leg an inclination to the vertical.

On the other hand where floor space is limited but ample headroom is available, the vertical water leg permits of large capacity units being installed.

The same is true in regard to pressures. In modern power plant practice, pressures are ranging from 300 to 600 pounds per square inch and Collins boilers can readily be built to safely withstand the stresses imposed by these high pressures and the temperatures that accompany them.

The advantages of the design of the Southwestern Collins Safety Water Tube Boiler may be summed up as follows:

It can be manufactured in larger units at lower costs.

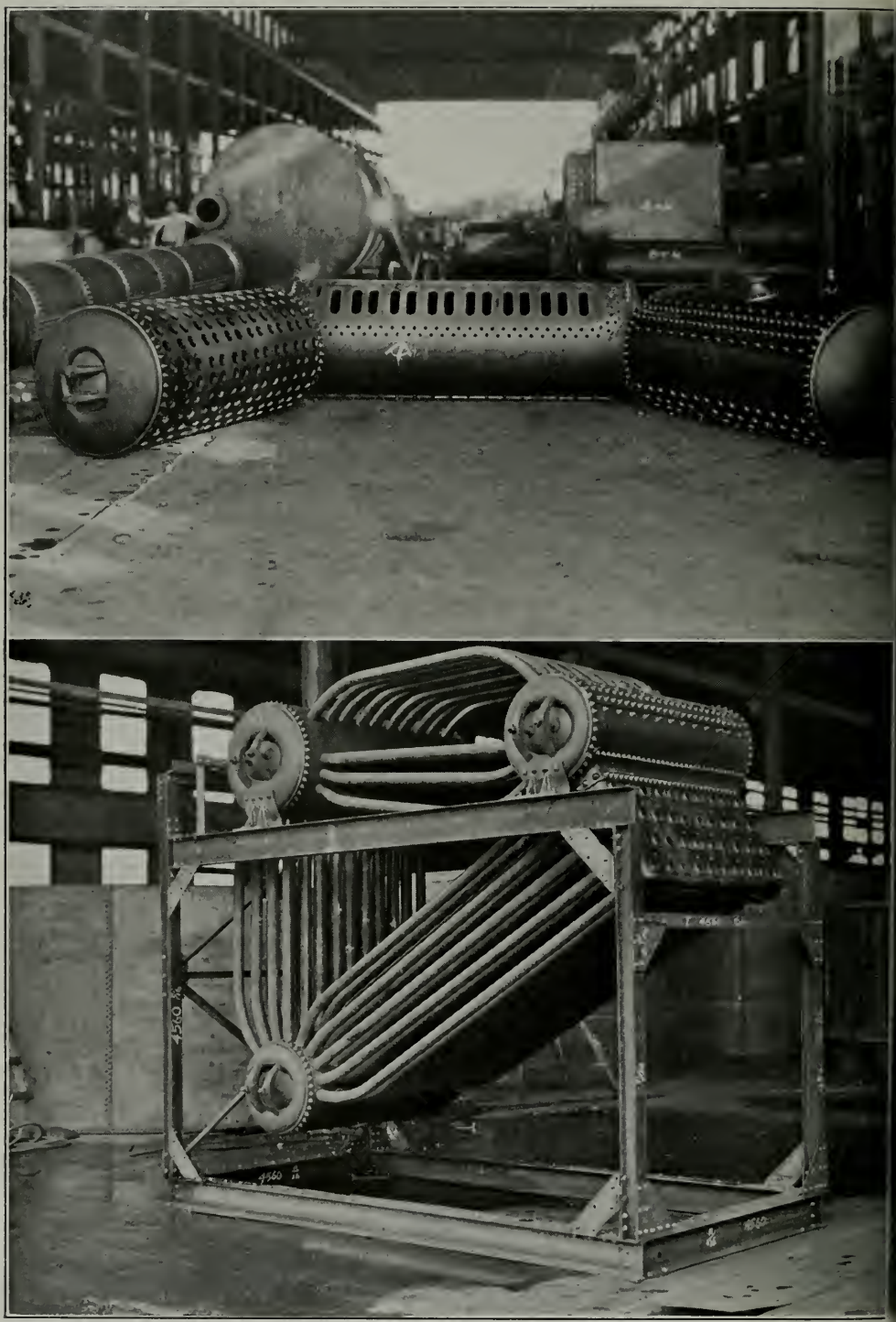
The boiler will develop tremendous overloads without undue harmful effect.

All parts are easily accessible for cleaning and repairs, including tube renewals. More rapid steaming qualities.

Lower cost of maintenance. Reduction of lost time for repairs and cleaning. Possibility to build for higher pressures. Contains large volume of water for reserve. Has better proportions and arrangements for expansions and contractions.

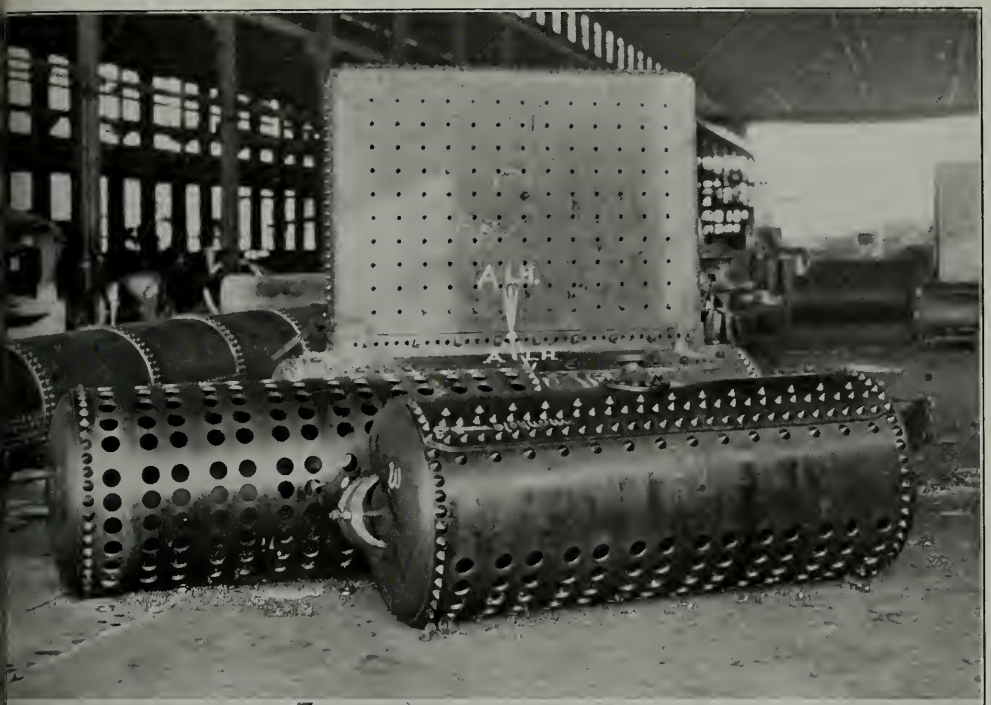
Requires smaller space for large installations. Generates a better quality of steam.

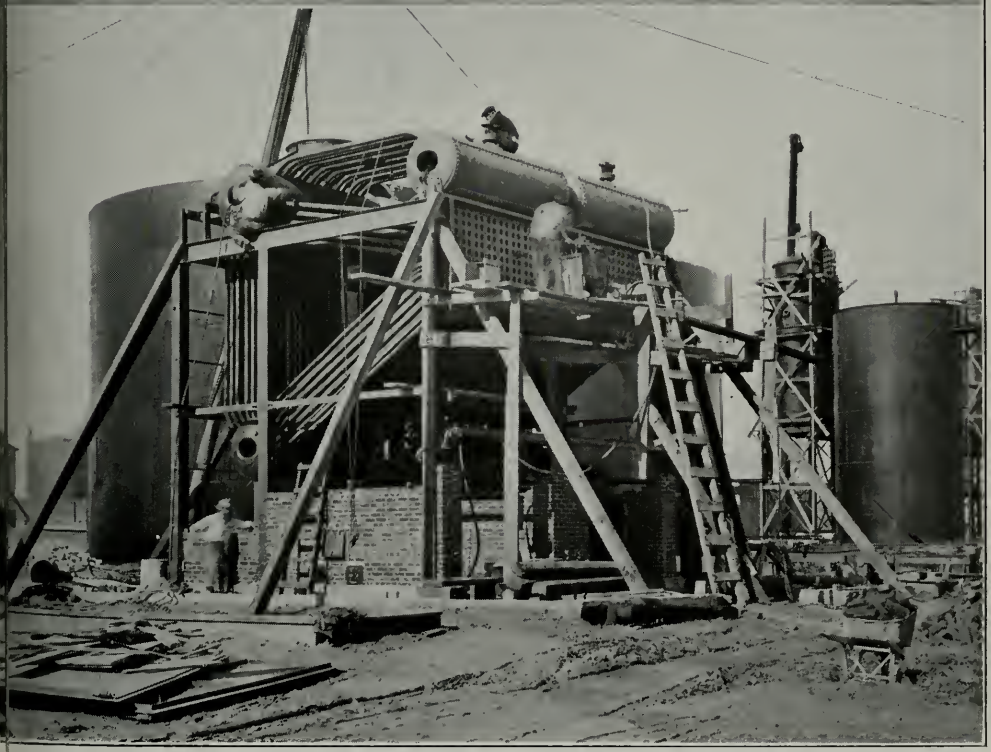
More readily adapted to superheaters. Less danger from explosion.



SOUTHWESTERN COLLINS SAFETY WATER TUBE BOILERS IN C

Western Pipe & Steel and show boiler drums and water legs in process of manufact right shows a battery of Collins water tube boilers in course of erection. This insta picture illustrates admirably the ease of access to the tubes for cleaning.





OF FABRICATION—*Upper pictures are shop views taken at Los Angeles plant of*
er left shows an 80 H. P. portable type boiler assembled and ready for testing. Lower
s for one of the large oil companies, and consists of two type B boilers, 264 H. P. This

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SO many buyers of products fabricated from steel are inclined to think of Western Pipe & Steel mainly as manufacturers of riveted or welded pipe, black or galvanized tanks, corrugated culverts, penstocks, oil and water well-casing, etc., that it seems timely to call attention to some of the many special products that are constantly passing through our shops.

In this issue, therefore, we present comprehensive articles on Collins Boilers and Trumble Gas Traps, with illustrations of these and other specials. We feel that these articles and pictures will drive home the point that besides all standard fabricated steel products we are also equipped to turn out all classes of special work.

Attention is directed to the double cover picture, which shows a portion of the great fleet of over 100 motor trucks of the Richfield Oil Co. at Los Angeles. Every tank on these trucks was designed and manufactured by W. P. & S. These turtle-back tanks are notable in that they have a very low center of gravity. This makes for speed with safety. The Richfield Los Angeles fleet holds a record for having delivered over 700,000 gallons of gasoline in a 7-day period. Their daily delivery often passes 100,000 gallons. Trucks like these are in Richfield service all the way from Tijuana to Yuba City.

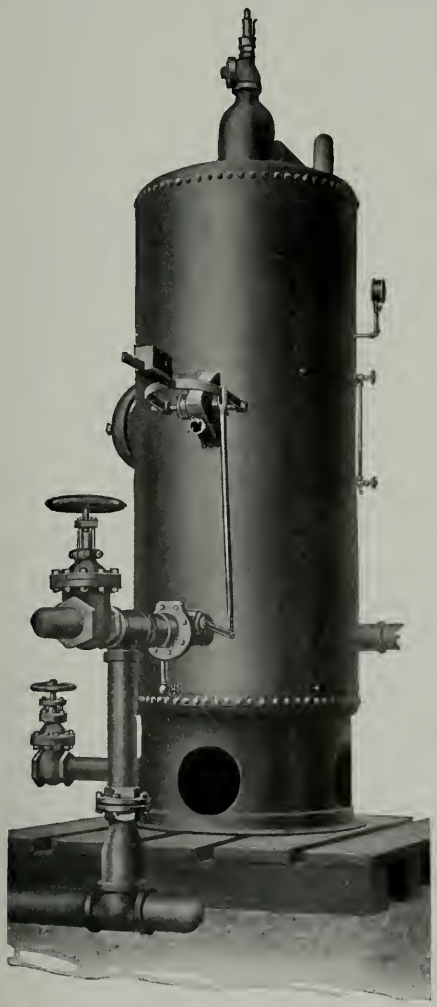
Western Pipe & Steel builds truck tanks of all types and sizes to any specifications, including turtle-back, round, elliptical, sectional, single compartment, and multiple compartment. The tank with trailer illustrated below has been called the successor to the railroad tank car. This 6-wheel truck tank, which is 5′ 6″ diameter and 17′ long, carries 2900 gallons and the trailer, 4′ 6″ x 18′, 2100 gallons, a total of 5000 gallons, or nearly half the capacity of an ordinary tank car. They are used for the transportation of refinery products, gasoline, kerosene, etc., in large quantities. Those intended for service carrying high gravity casing-head gas in hot regions have a cork insulation 3″ thick.

Truck tank and trailer built by W. P. & S. for Lang Transportation Co. The combined capacity of the two tanks is 5000 gallons. Richfield Oil Co. and Associated Oil Co. are among others for whom large numbers of these tanks are made by W. P. & S.

The Trumble Oil and Gas Separator

A STRIKING example of the endless variety of special work which is fabricated in the shops of Western Pipe & Steel for various customers is found in the Trumble Oil and Gas Separator illustrated on this page.

The Trumble Gas Trap is the pioneer device designed for the separation of oil and gas. A brief description of its functions may be in order. Gas, as it comes from the well under pressure, is intimately mixed with the oil. If the pressure is released, as when the oil flows into an open tank, the expanding gas leaving the oil carries with it a considerably larger amount of the lighter portions of the oil than would be the case if it were held under pressure until it had freed itself from the oil body.



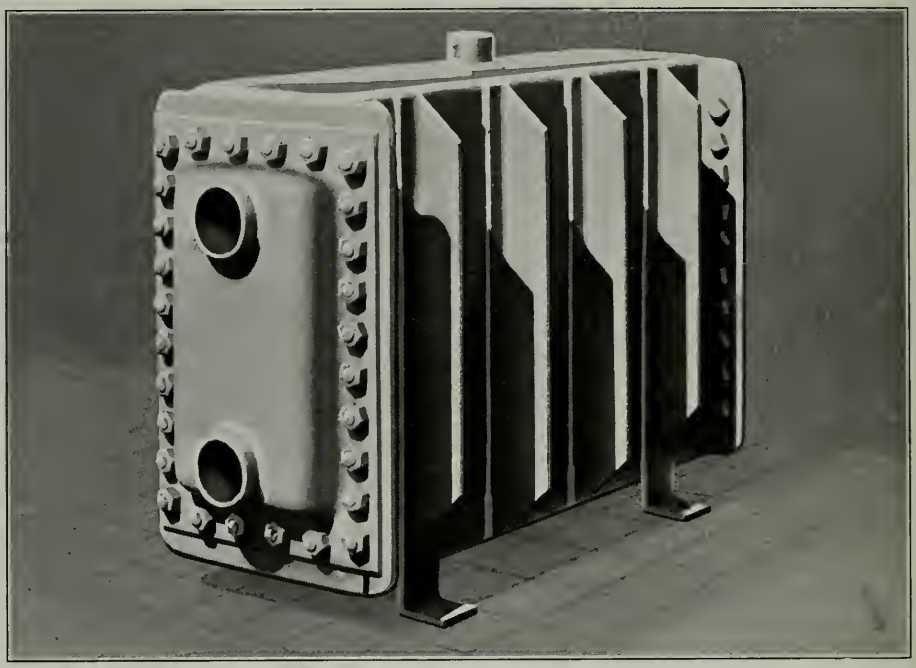
The Trumble Oil and Gas Separator, made by W. P. & S.

When once taken up by natural gas, gasoline requires more pressure to recondense than is required for the purpose of holding it in its natural oil body by maintaining a pressure while it is leaving the oil.

The Trumble Gas Trap admits the oil and gas into a chamber which is so designed that the oil spreads over the walls in a thin body, allowing the gas to escape from it. Pressure is maintained by restricting the outlets and this prevents the gas from expanding and becoming a carrier for gasoline. Consequently, the gasoline is left in the oil and this increases the gravity as well as the quantity.

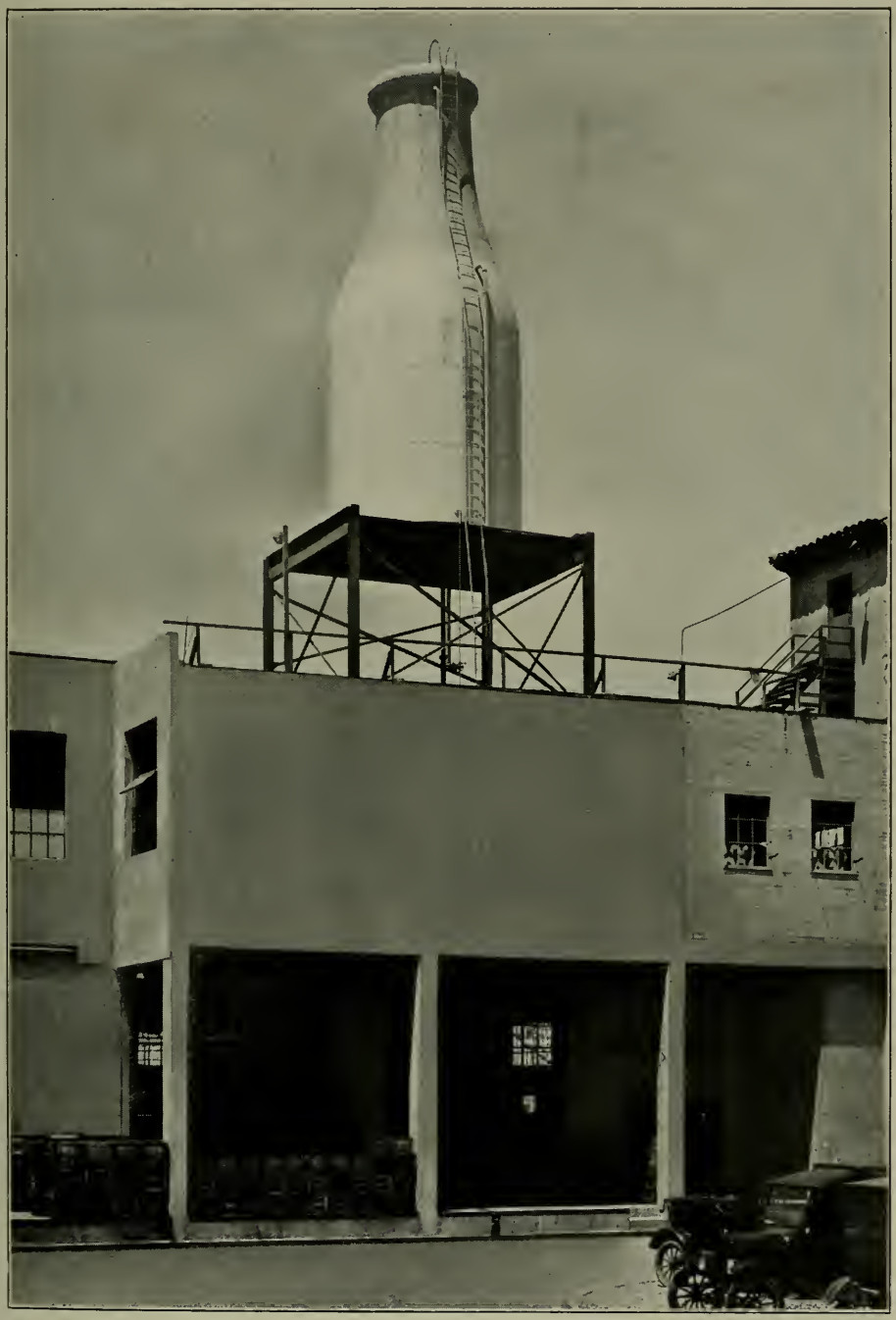
To give an idea of the sturdy construction of the Trumble Gas Trap, it may be stated that the No. 1 size, which is 10′ over all, with shell 6′ 6″ long, and 3′ in diameter, has a shell thickness of 3/16″, heads 1/4″. The No. 2 size is 12′ over all, shell 8′ long and 3′ 6″ in diameter with shell 1/4″ thick and heads 5/16″. The largest size, No. 3, is 12′ over all, with shell 8′ long and 3′ 6″ in diameter with shell 1/2″ thick and heads the same. In this model 7/8″ rivets are used throughout. All models have manholes of the boiler crab type 15″ by 18″ with two bolts and crabs. Approximate shipping weights are as follows: No. 1, 1500 pounds, No. 2, 2200 pounds, No. 3, 3750 pounds.

Western Pipe & Steel manufactures these separators for the Trumble Gas Trap Company, Los Angeles.



One of the many items of oil refinery equipment manufactured by W. P. & S. is the heat exchanger shown above. The company has unsurpassed manufacturing facilities for equipment of this character.

Grease Dispensers manufactured by W. P. & S. at Los Angeles. This dispenser, known as the "Blue Gun," is revolutionizing greasing work at garages and service stations all over the coast. It is wheeled alongside a car, connected, and a touch on the air valve shoots the grease home under pressure.



THE MOST FAMOUS MILK BOTTLE IN CALIFORNIA—*The Crescent Creamery Co., Los Angeles, lets its roof pressure tank advertise its business. Built by W. P. & S., this steel bottle is 36 feet high, 15 feet diameter at the bottom, and holds 25,000 gallons of water. The bottle is illuminated at night and can be seen for many miles.*

WESTERN PIPE AND STEEL NEWS

U. S. INTERIOR DEPARTMENT BUYS W. P. & S. CULVERTS FOR MUIR WOODS—*This picture and the one on the cover were taken in Muir Woods, less than eleven miles from San Francisco. Good culverts are just as essential in parks as under paved highways.*

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Highway Officials of Nation Adopt New Standard Culvert Specifications

TO standardize specifications is the tendency of the times. Public officials, as well as corporation executives, engineers, and purchasing agents, are swinging into line in the movement toward common standard specifications for all classes of material.

The largest group of public officials in this country to throw the weight of its prestige behind this movement is the American Association of State Highway Officials, which has adopted standard specifications for corrugated galvanized metal pipe culverts.

These specifications have been broadcasted by the association throughout the United States and the view is generally held by engineers and manufacturers that their universal adoption will be accomplished in a short time. United States Government departments began utilizing them forthwith.

Western Pipe & Steel considers this subject of such wide interest and far-reaching importance as to merit the greatest possible exploitation, therefore this number of WESTERN PIPE & STEEL NEWS is devoted to giving, practically in their entirety, the culvert specifications adopted by the American Association of State Highway Officials.

With five modern and completely equipped factories on the Pacific Coast, Western Pipe & Steel is unsurpassed in its facilities for the manufacture of culverts. Our experience in this field goes back over many decades and our record as culvert manufacturers may be read in thousands of culverts installed on the Pacific Coast, all the way from Alaska to Mexico.

As with other manufactured articles, there are but two factors in the manufacture of good culverts. The first, necessarily, is good material, the second is conscientious workmanship.

As to the question of material, we thoroughly believe that in Keystone Copper Steel we have a material which is not equaled for rust-resisting qualities. Every culvert manufactured by this company is made of Keystone Copper Steel which is not only heavily galvanized but has a galvanized coating that sticks. Rust being the principal factor of destruction in culverts, the importance of good metal properly coated can hardly be over-emphasized. The superiority of copper-bearing steel over non-copper materials has been repeatedly demonstrated in tests made under the strictest official supervision. These tests leave no doubt as to the importance of the presence of copper in any material designed to resist rust.

We recommend a careful reading of the following specifications to every engineer, purchasing agent, highway official, county and municipal official, and good roads enthusiast under whose eye this article falls:

American Association of State Highway Officials—Specifications for Corrugated Galvanized Metal Pipe Culverts, 1925

MATERIALS.

1. Base Metal.

Corrugated metal pipe culverts shall be fabricated from corrugated galvanized sheets, the base metal of which shall be made by the open hearth process. The base metal in the finished sheets shall conform to the following chemical requirements:

The total amount of carbon, phosphorus, sulphur, manganese and silicon shall not exceed 0.7 per cent. If the total of these five elements equals or exceeds 0.20 per cent, the metal shall contain not less than 0.17 per cent copper and not more than 0.06 per cent of sulphur. If the total of these five elements is less than 0.20 per cent, the presence of copper is optional and sulphur shall not exceed 0.04 per cent.

2. Rivets.

All rivets shall be of the same material as the base metal specified for the corrugated sheets. They shall be thoroughly galvanized or sherardized.

3. Weight Tolerance.

The average weight per square foot of the culvert sheets, as determined by weighing in lots not exceeding 6,000 pounds, shall not vary from the theoretical weight by more than five per cent (5%) either way for each lot of one gauge and size.

4. Spelter Coating.

Weight of Spelter Coating: The base metal sheets shall be uniformly galvanized on both sides by the hot process. A uniform coating of Prime Western Spelter shall be applied at the rate of not less than two (2) ounces per square foot of metal. If the average spelter coating as determined from samples shows less than two (2) ounces of spelter per square foot of metal, or if any one sample shows less than 1.8 ounces of spelter per square foot of metal, the shipment shall be rejected. Sheets having blister spots, holes or other imperfections in the galvanizing after corrugating shall be rejected.

Tests for Spelter Coating: The test for weight of spelter coating shall be made in accordance with the methods provided in the Tentative Standard Methods of Sampling and Testing of the American Association of State Highway Officials.

5. Accepted Brands of Metal.

No metal will be accepted under these specifications and no bids will be considered for the materials above described until after the sheet manufacturer's certified analysis and manufacturer's guarantee have been passed upon by the engineer and accepted.

Misbranding or other misrepresentation, and non-uniformity of product, will each be considered a sufficient reason to discontinue the acceptance of any brand under these specifications, and notice sent to the sheet manufacturer of the discontinuance of any brand will be considered to be notice to any culvert companies which handle that particular brand. The brand of metal furnished shall be specified in the bid.

6. Sheet Manufacturer's Certified Analysis.

The manufacturer of each brand shall file with the engineer a certificate setting forth the name or brand of metal to be furnished and a typical analysis showing the percentage of each of the five above-mentioned chemical elements. The certificate shall be sworn to for the manufacturing company by a person having legal authority to bind the company.

7. Sheet Manufacturer's Guarantee.

The manufacturer of the sheets shall submit with the certified analysis a guarantee providing that all metal furnished shall conform to the certified analysis filed, shall bear a suitable identification brand or mark, and shall

be replaced without cost to the purchaser when not in conformity with the specified analysis, gauge, or spelter coating; and the guarantee shall be so worded as to remain in effect so long as the manufacturers continue to furnish material.

8. Identification.

No culverts will be accepted unless the metal is identified by a stamp on each section showing:

1st. Name of sheet manufacturer.
2nd. Name of brand.
3rd. The gauge.

The identification brands shall be placed on the sheets by the manufacturers of the sheets, in such a way that when rolled into culverts, such identification shall appear on the outside of each section of each pipe. Pipe having any sections not so stamped shall be promptly rejected.

9. Laboratory Tests.

When not otherwise provided, laboratory tests shall be made in accordance with the methods of the American Society for Testing Materials and by the chemist or inspection bureau designated or approved by the engineer. No considerable shipment of metal shall be rejected until after a check analysis has been made. In any case in which the analysis of the base metal is in dispute, the question may be referred to an umpire chemist, mutually satisfactory to both parties, whose decision shall be considered final.

10. Mill and Factory Inspection.

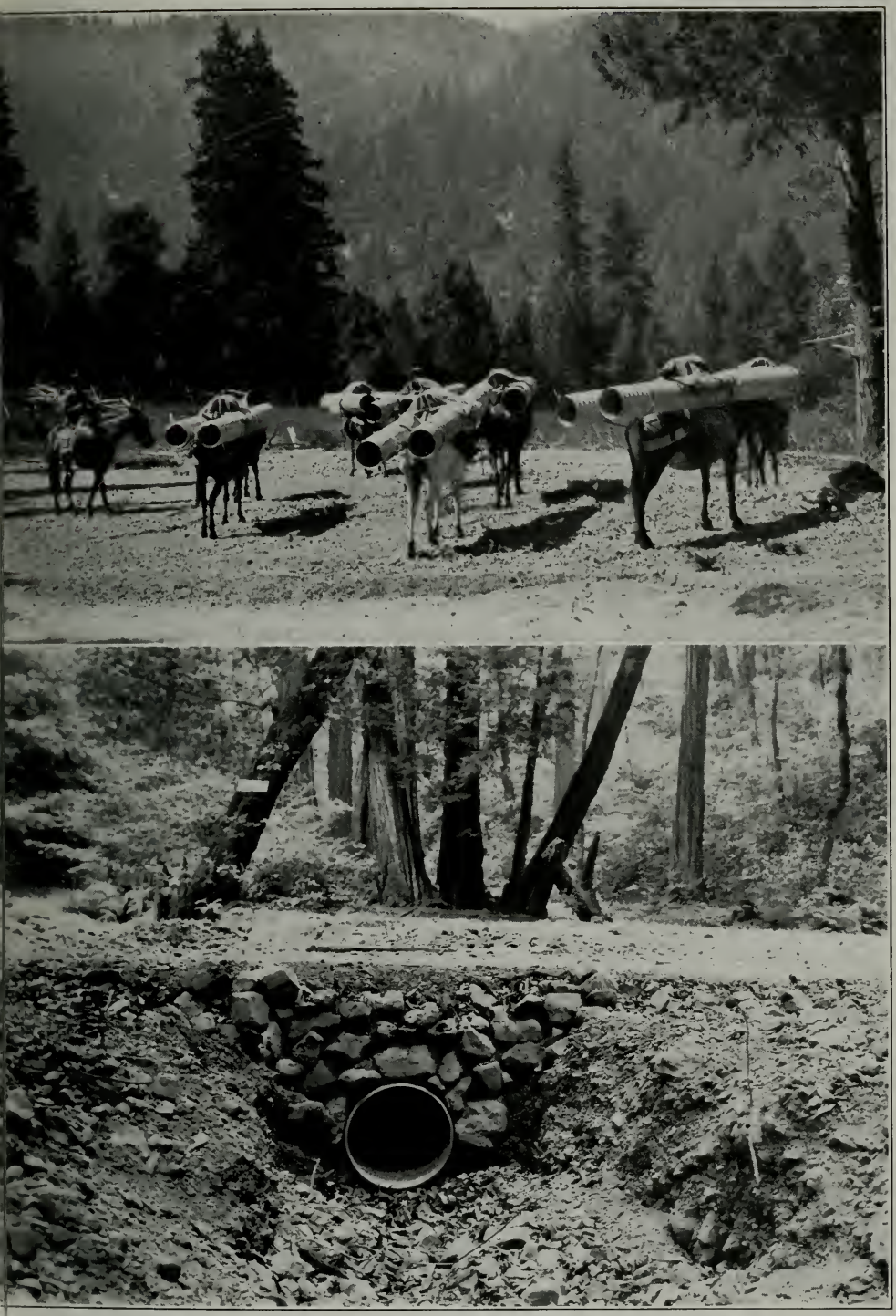
If the engineer so elects he may have the material inspected at the rolling mill or the culverts inspected in the shop where they are fabricated. He may require from the mill that a chemical analysis be made of any heat. The inspection both at the mill and at the shop shall be made under the direction of the engineer. The engineer, or his representative shall have free access to the mill or shop for inspection purposes, and every facility shall be extended to him for this purpose. Any material or pipe included in any shipment which has been rejected at the mill or shop will be considered sufficient

(*Continued on page 8*)

W. P. & S. Culvert on the world-famous Skyline Boulevard, South of San Francisco. This picture was taken near Colma.

WESTERN PIPE & STEEL KEYSTONE GALVANIZED CORRUGATED

Pacific Highway, between Redding and Dunsmuir. Many culverts were used in the S.
right—Transporting W. P. & S. culverts by mule-back into the Klamath River countr
Francisco built the Hetch Hetchy Railroad, in the High Sierras, many W. P. & S. cu
ment for Muir Woods, just across the bay from San Francisco.



RTS ARE WIDELY DISTRIBUTED IN CALIFORNIA—*Upper left—Scene along the ay Commission's plan of shortening curves and widening grades in this section. Upper S. Bureau of Public Roads sent us this picture. Lower left—When the City of San installed. Lower right—One of the many culverts furnished the U. S. Interior Depart-*

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY

of California

444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES

EDITED BY EDWARD F. O'DAY

ANY discussion on the subject of galvanized corrugated culverts would be incomplete without some reference to what is known to the trade as the Pittsburgh Tests.

These tests, which were made under the direction of the American Society for Testing Materials, covered a period of six years and three months, from December 12, 1916, to March 9, 1923. The purpose of the tests, for which several hundred uncoated black sheets were furnished by leading manufacturers, was to determine the relative rust resistance of copper-bearing material and non-copper-bearing, some of which was alleged to be "pure iron."

A resume and analysis of the authorized copyrighted report of the American Society for Testing Materials, was printed in the February, 1925, issue of this magazine, and a copy of the official report was enclosed with it. However, with the adoption of new standard specifications for corrugated galvanized metal pipe culverts by the American Association of State Highway Officials, there is a renewed interest in the results of the Pittsburgh Tests which warrants a further exposition of the failures of non-copper-bearing materials.

It may be well to quote here from the opening paragraphs of the specifications adopted by the American Association of State Highway Officials:

"Corrugated metal pipe culverts shall be fabricated from corrugated galvanized sheets, the base metal of which shall be made by the open hearth process. The base metal in the finished sheets shall conform to the following chemical requirements:

"The total amount of carbon, phosphorus, sulphur, manganese and silicon shall not exceed 0.7 per cent. If the total of these five elements equals or exceeds 0.20 per cent, the metal shall contain not less than 0.17 per cent copper and not more than 0.06 per cent of sulphur. If the total of these five elements is less than 0.20 per cent, the presence of copper is optional and sulphur shall not exceed 0.04 per cent."

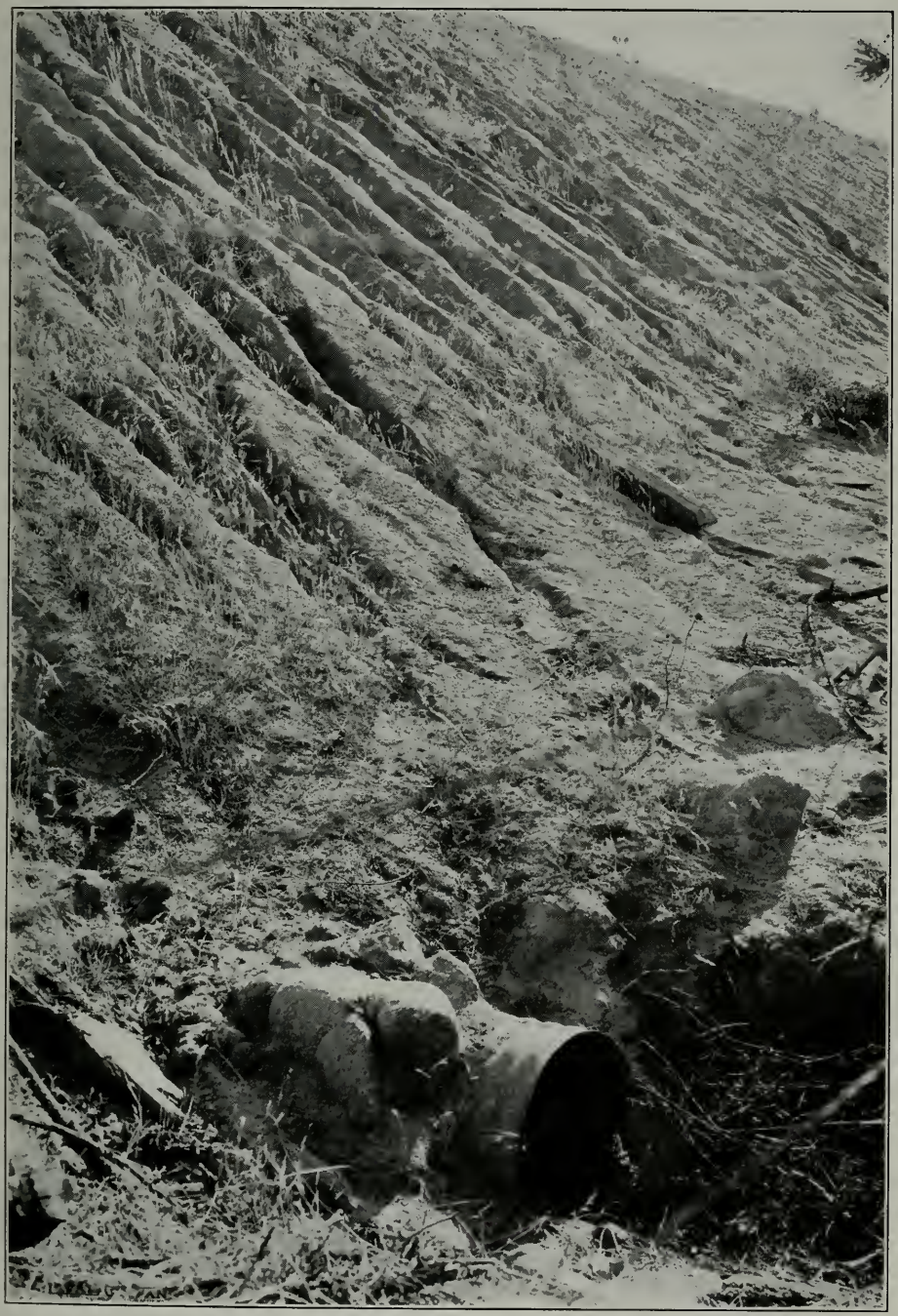
Thus it may be seen that, taking the first chemical requirements, the metal must contain not less than 0.17 per cent copper. In the Pittsburgh Tests one lot of Keystone copper-bearing sheets, (from which all Western Pipe & Steel culverts are fabricated) included fifteen No. 16 gauge sheets of copper-bearing basic open-hearth steel, in which the average analysis showed 0.237 per cent copper. This lot as well as every other lot of copper-bearing No. 16 gauge sheets scored 100 per cent perfect in the tests.

In other words, there was not a failure of any of these copper-bearing sheets in the entire period of 75 months.

On the other hand, some of the so-called "pure iron" failed to make the grade. Of one lot of non-copper-bearing sheets all but six failed at forty-one months and the remaining six in forty-six months.

Taking the summary of all the No. 16 gauge sheets in the Pittsburgh Tests, we find that, while no failure was recorded among the copper-bearing sheets, of 126 non-copper-bearing sheets only 24 survived to the end of the tests. Only 12% of the so-called "pure iron" stood up.

This would seem to answer, once and for all, any question as to the merits of copper-bearing materials. Certainly the Pittsburgh Tests justify our claim that Keystone copper steel galvanized corrugated culverts have the highest rust resistance of any material known.



W. P. & S. culvert under a deep rock fill on the line of the Minarets & Western Railroad, in the high mountains back of Fresno. The best of materials and workmanship is necessary in installations of this kind.

(*Continued from page 3*)

cause for the rejection of the entire shipment.

CONSTRUCTION.

3. Dimensions & Weights.

The length of sheets, widths of laps, gauge of the uncoated metal (United States Standard Gauge) and theoretical weight per linear foot of the finished culverts, shall be as specified in the following table. The dimensions given for diameter of pipe are nominal. The average weight per linear foot of a finished culvert, exclusive of end finish, shall not under-run the theoretical weight specified by more than five per cent (5%):

Nominal Diameter Inches	Length of Sheet before forming Inches	Width of Lap Inches	Minimum Gauge U. S. Std.	Theoretical Wt. Per Lin. Ft. of Finished Culvert Exclusive of End Finish Pounds
12	40	2.0	16	10.5
15	50	2.0	16	13.1
18	60	2.5	16	15.7
21	70	2.5	14	22.5
24	80	3.0	14	25.8
30	100	3.5	14	32.2
36	120	3.5	12	53.3

6. Corrugations.

Corrugations shall be not less than two and one-quarter (2¼) nor more than two and three-quarters (2¾) inches center to center. The corrugations shall have a depth of not less than one-half (½) inch.

10. Workmanship.

It is the essence of these specifications that in addition to compliance with the details of construction, the completed pipe shall show careful, finished workmanship in all particulars.

Culvert pipe on which the spelter coating has been bruised or broken either in the shop or in shipping, or which show defective workmanship, shall be rejected.

The requirement applies not only to the individual pipe, but to the shipment on any contract as a whole. Among others, the following defects are specified as constituting poor workmanship and the presence of any or all of them in any individual culvert pipe or in general in any shipment, shall constitute sufficient cause for rejection.

(1) Uneven laps.

(2) Elliptical shaping.

(3) Variation from a straight center line.

(4) Ragged or diagonal sheared edges.

(5) Loose, unevenly lined or spaced rivets.

(6) Poorly formed rivet heads.

(7) Unfinished ends.

(8) Illegible brands.

(9) Lack of rigidity.

(10) Bruised, scaled or broken spelter coating.

(11) Dents or bends in the metal itself.

11. Field Inspection and Acceptance of Pipe. (part)

Sampling: When samples are taken for chemical analysis and determination of weight of spelter coating, at least one sample from which a specimen two and one-quarter (2¼) inches square may be prepared, shall be selected from each ten (10) culverts of a shipment, and not less than three (3) samples shall represent any one shipment.

FABRICATING A CULVERT FOR THE U. S. GOVERNMENT—*This giant culvert, five feet in diameter by forty-two feet long, was recently made at the South San Francisco plant of Western Pipe & Steel.*

"WESTERN"

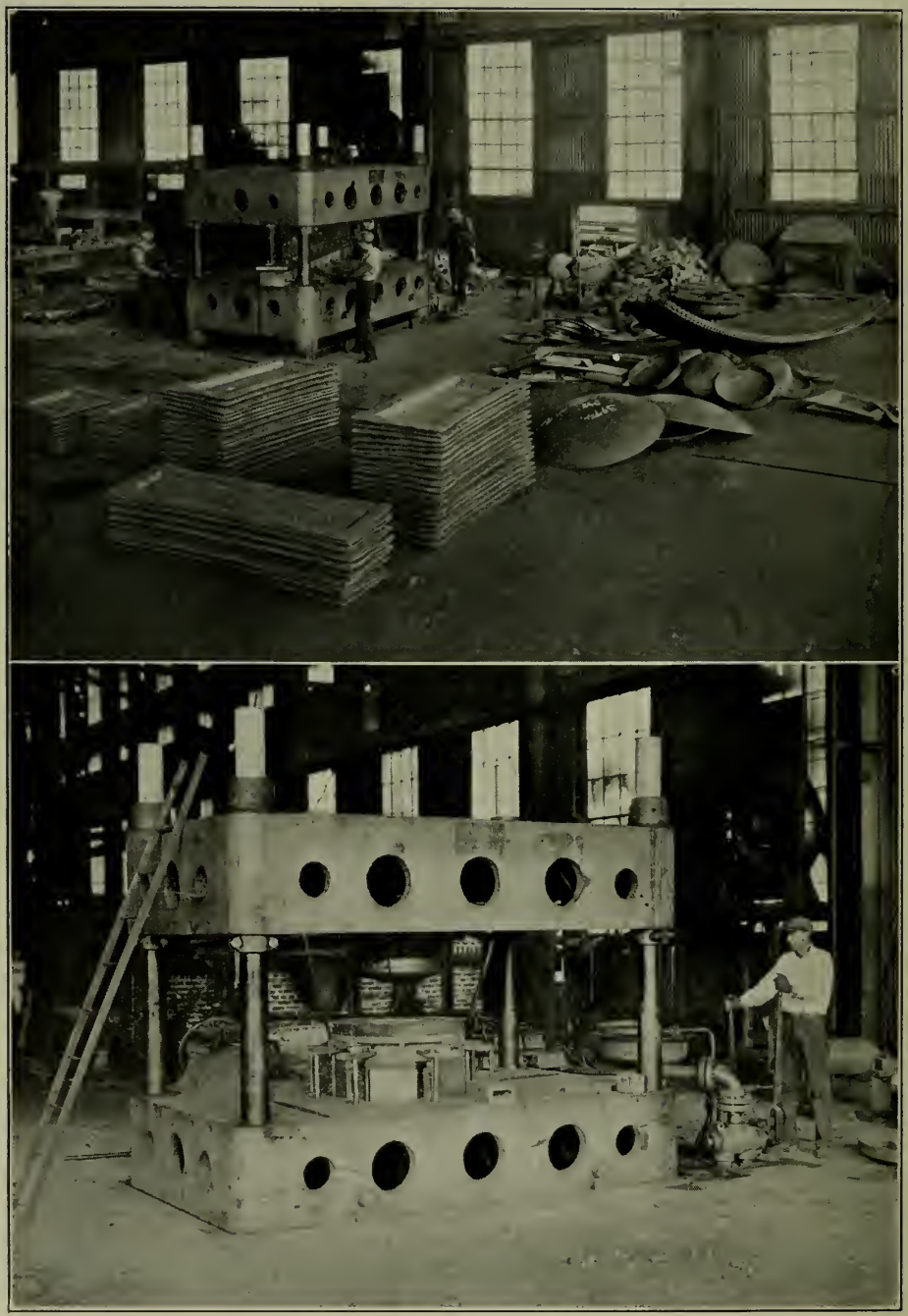
Keystone Copper Steel Galvanized Corrugated Culverts

are used by

California Highway Commission
Arizona Highway Commission
Nevada Highway Commission
Most Counties in these States
U. S. Bureau of Public Roads
U. S. Forest Service
Southern Pacific Co.
Santa Fe R. R.
Minarets & Western R. R.
Hetch Hetchy R. R.
Sutter Basin Co.
Reclamation District No. 1500
Reclamation District No. 1660

Other buyers of "Western" Culverts include Corporations, Municipalities and Individuals in all sections of the Pacific Coast. Their experience is the same as ours—that no material equals Keystone copper-bearing steel in rust-resistance.

WESTERN PIPE AND STEEL NEWS



NEW SHOP EQUIPMENT AT LOS ANGELES INCLUDES THIS HUGE HYDRAULIC PRESS—*Top picture shows some of the pressed steel products, including flanged and dished heads, ⅜" cover plates, etc. The press is 390-tons capacity, and weighs 142,000 lbs. Most of it is underground.*

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME II SEPTEMBER-OCTOBER, 1925 NUMBER 8

Improved Equipment Opens New Era of Development for W. P. & S.

IT is an ancient saying that two of the most important of all inventions in the development of civilization and the destiny of man, were the lever and the wheel. The great Archimedes said: "Give me a fulcrum, and with my lever I shall move the earth." Archimedes would be amazed if he could return today and see what the ingenuity of man has accomplished in adapting the lever and the wheel to modern manufacturing requirements.

Even moderns, familiar as they are with the miracles wrought in the field of mechanics, are at times amazed at the things that are done with machine tools. One of the problems of the aggressive modern manufacturer is to keep pace with the demands of our gigantic industries. Equipment that saves labor, time, material—and therefore money—is the first essential of successful manufacturing.

Western Pipe & Steel has always striven to keep up with the development of new equipment. Within the past few months new machines running into heavy cost have been installed at the various plants operated by this company. This has been done in the cause of manufacturing efficiency which, translated, means better service to customers at a lower cost.

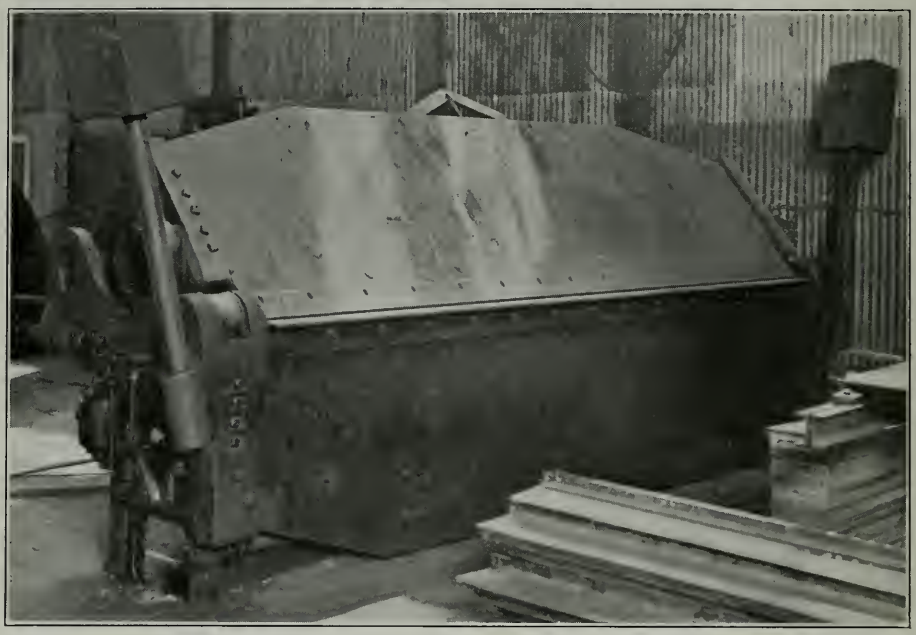
At our Los Angeles plant, we have just installed a 390-ton hydraulic 4-column press of the up-working type which represents the last word in the manufacture of pressed steel products. This machine will turn out anything from flanged or dished heads to pressed steel car sills.

There has also been installed at Los Angeles a 150-ton press that will take care of as many as seven operations at one stroke, including shearing, punching, notching corners, cutting, flanging, and forming. One use of this machine is to manufacture such products as ice cans. It is also used in bending flanges on bolted tanks.

At South San Francisco new shop equipment includes an angle bending roll for forming heavy material, heretofore done by blacksmith work. This machine will take cold angles up to 6"x6"x¾".

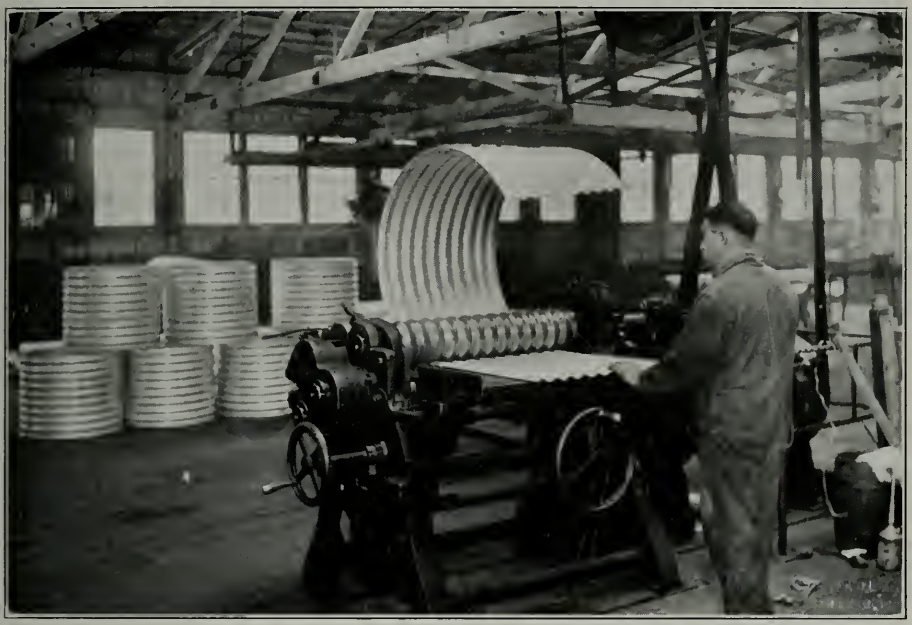
Also at South San Francisco, we have recently installed a 100-ton hydraulic flanging press that is a marvel of mechanical ingenuity. In the galvanizing shop new equipment includes a 12-foot forming press. This is used for making concrete forms and similar products.

While it has always been the policy of Western Pipe & Steel to encourage its customers and friends to visit the various plants and follow through the different operations in the process of manufacturing, we realize that a great many have not been able to take advantage of such an invitation. And so in this number of Western Pipe & Steel News, we bring to their eyes pictures of some of the more striking examples of our shop and field equipment.

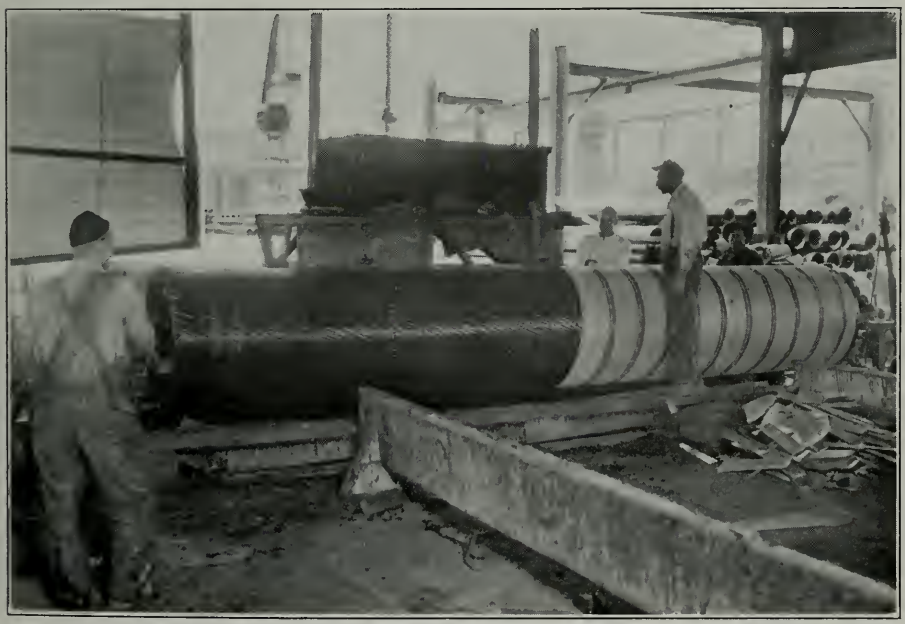


This formidable looking machine is a heavy duty break. It will bend a steel plate ⅜" thick and 14 feet wide to a right angle.

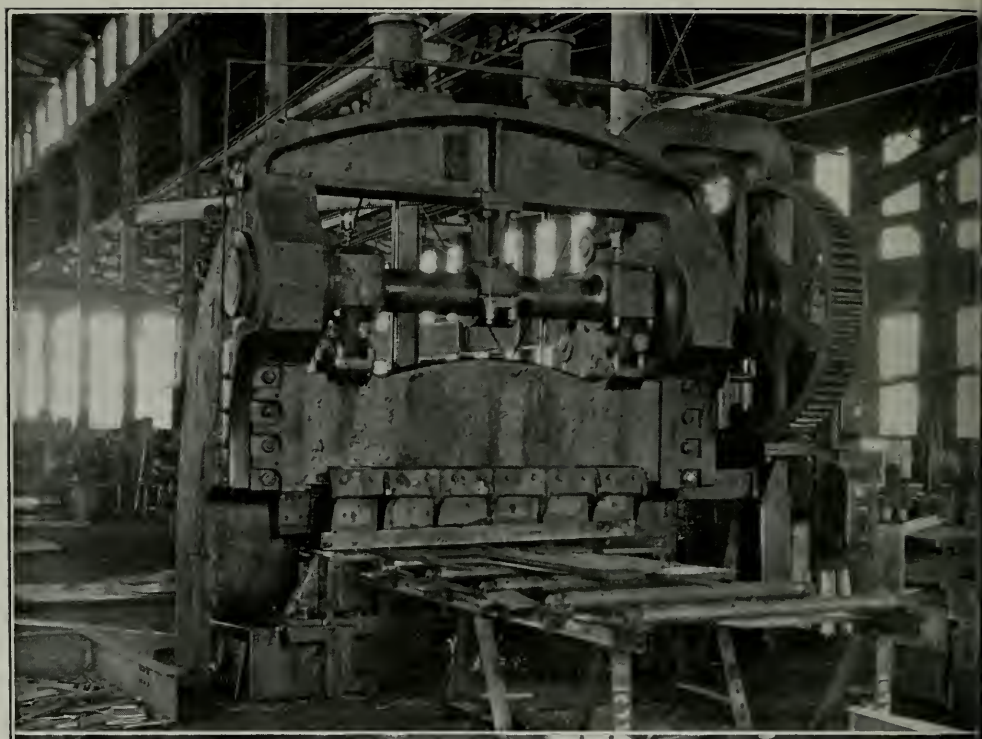
One of the busiest units of our Los Angeles plant. This 150-ton press can be set up to perform seven operations at one stroke. It is used for bending flanges, shearing, punching, etc.



Culvert rolling machine in the galvanizing shop at South San Francisco. It rolls the sheets into circular form preliminary to making up sections as shown in the background.

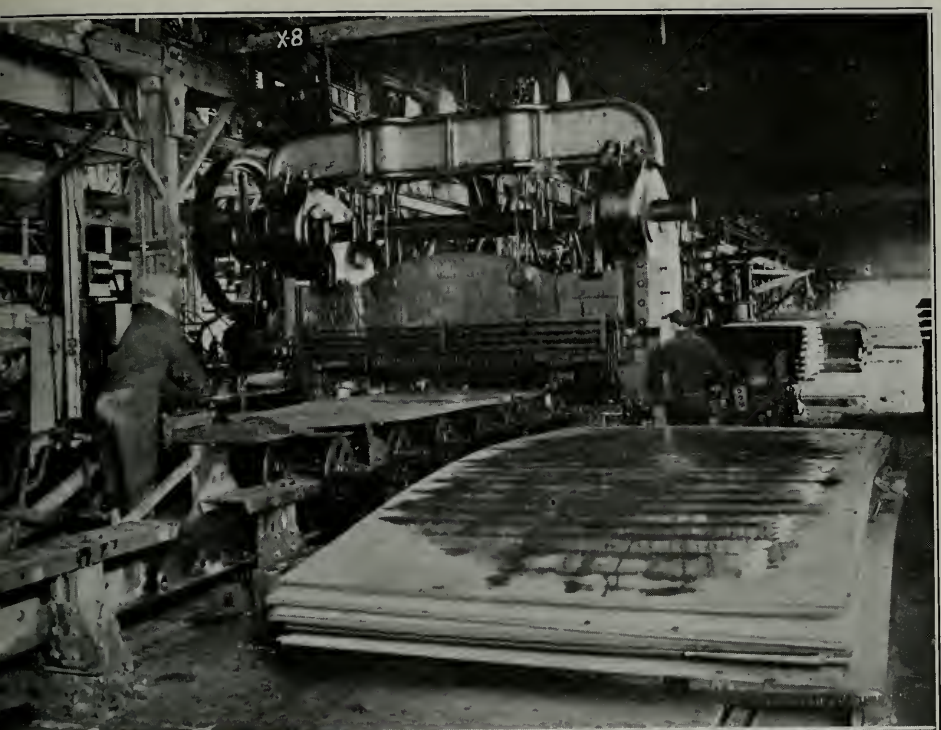


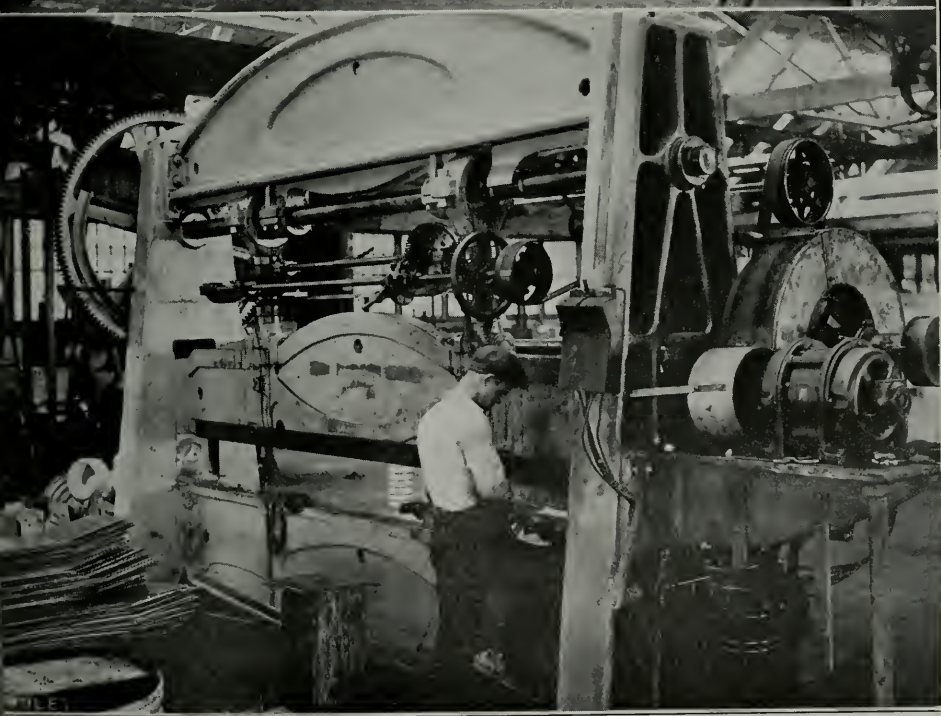
Applying soil-proof wrapping to riveted steel water pipe at our Los Angeles plant. W. P. & S. was the pioneer in the field of soil-proof pipe manufacture.



FOUR VIEWS OF WESTERN PIPE & STEEL SHOP EQUIPMENT SHO

Angeles. This giant will punch at one stroke forty 15/16" holes through a steel pla shear and punch is in the heavy plate shop at South San Francisco. The plate on th forty-eight 9/16" holes in 12 gauge sheets 10-feet wide, and to break 10 gauge sheets 1 at South San Francisco. It is used for making concrete forms, etc.





: OF THE HEAVYWEIGHTS—*Upper left—Combination punch and shear at Los* *equivalent to exerting a ram pressure of* 1,200,000 *pounds). Upper right—This* 8*-foot* *thick. Lower left—Combination break and punch at Los Angeles. Capacity to punch* *Lower right—This* 12*-foot forming press has been installed in the galvanizing shop*

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BECAUSE it is obviously impossible for every engineer, purchasing agent or other interested official to visit the manufacturing plants of Western Pipe & Steel Co., we are devoting this issue to a pictorial presentation of some of our shop equipment.

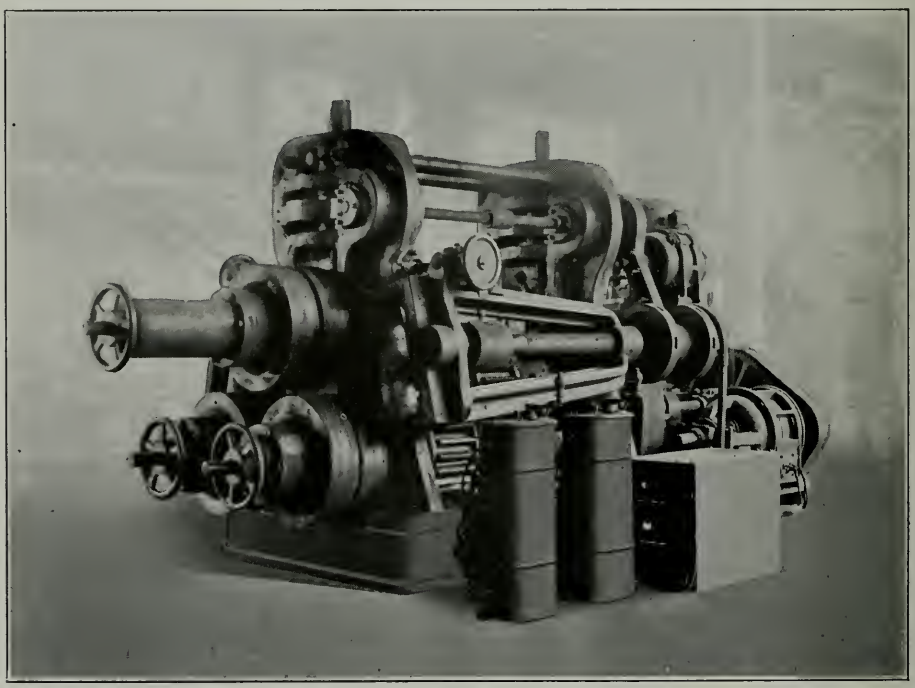
The illustrations tell their own story and we believe it is impressive.

They cannot tell the whole story, however, for it would require a magazine of several hundred pages to picture all of the equipment in the five manufacturing plants of W. P. & S.

The pictures here presented were selected with a view to showing first, the wide range of this company in the fabrication of products from steel plates and sheets; second, the fact that much of our equipment is above the commonplace in character. We doubt if there is any like concern that is so well equipped.

In addition to striking views of shop equipment, we present also some views of our field equipment. Here, as with the shop equipment, a book would be required to show everything. In the field, when it comes to installation or erection, Western Pipe & Steel has a reputation that matches its standing in the matter of design and fabrication, and to maintain this reputation it always keeps abreast of the latest improvements in equipment.

OUR COVER PICTURE—Our cover, this issue, is a silhouette snapped at South San Francisco. Note how art interprets the beauty of an industrial crane.



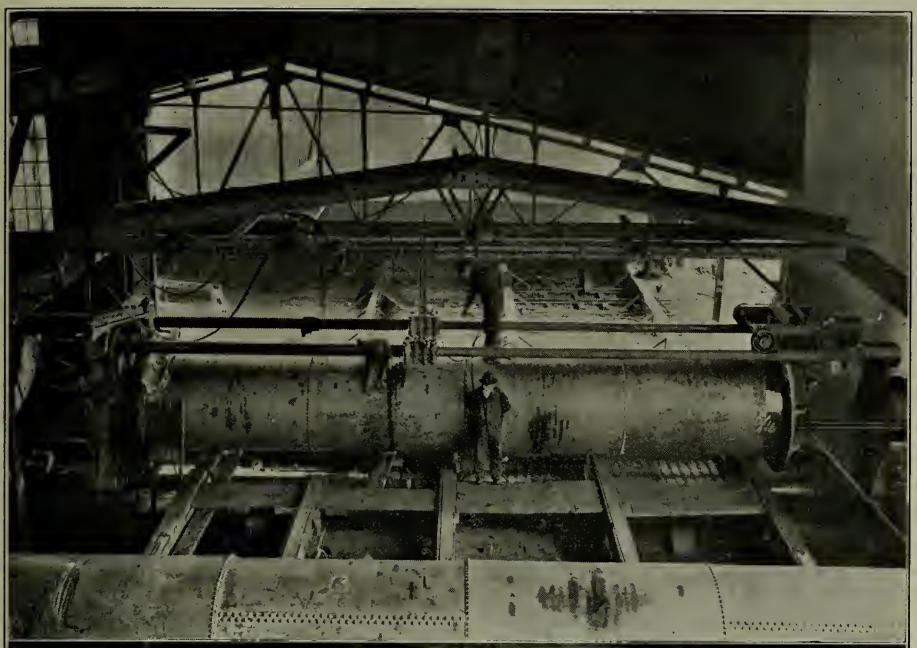
Angle bending roll recently installed at our South San Francisco plant. Used for forming heavy material. This machine will take cold angles up to 6" x 6" x ¾". It handles jobs formerly done by blacksmith work.

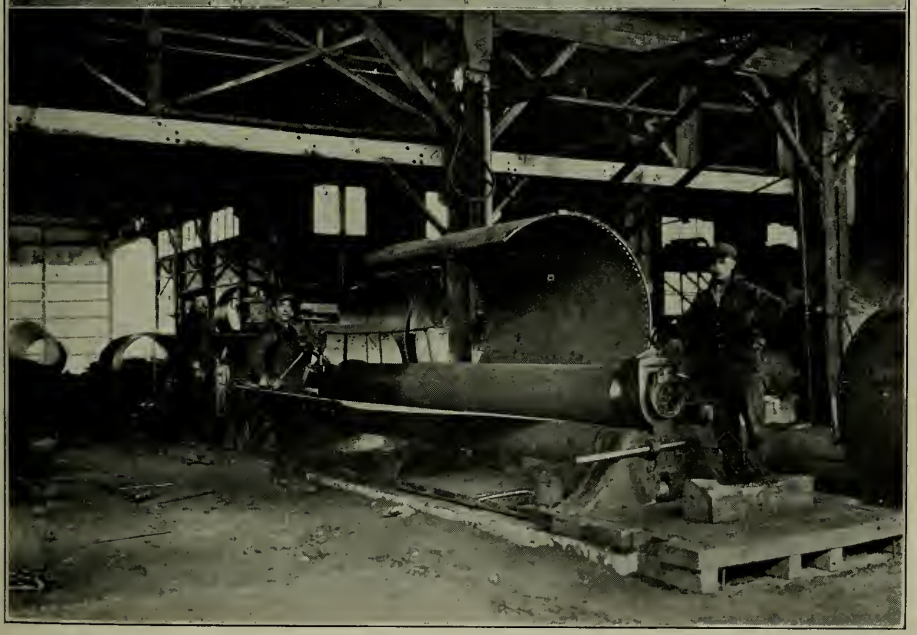
General view of the heavy plate department at Los Angeles plant of W. P. & S. In the line of punches at the left are machines that will punch 1¼" holes in plates 1" thick.

The galvanizing department at Los Angeles is a busy place, as this picture shows. The machine at the left is a 4' punch. Only about one-third of the shop is shown here.

All equipment isn't in the shops, as this picture of an air compressor in the field shows. Installation of the Hell-hole syphon of the San Diego Water Co.

Here in action is a 10-ton caterpillar crane with 35-foot boom laying W. P. & S. soil-proof pipe to bring water to Vallejo. Good field equipment efficiently handled is a W. P. & S. specialty.





TWO INTERESTING PICTURES OF SHOP EQUIPMENT AT SOUTH SAN FRANCISCO—*Top—Testing machine (hydraulic). Every section of pipe fabricated by W. P. & S. gets its trial by pressure in this machine. If it doesn't leak here it never will. Lower picture shows how steel plates are rolled into circular form in the manufacture of pipe.*

In the West It's "Western"

With this symbol of craftsmanship Western Engineers, Purchasing Agents, Contractors and other "Buyers of the Best" have come to associate *Quality* in Fabricated Steel Products

Western Pipe & Steel Co.

of CALIFORNIA

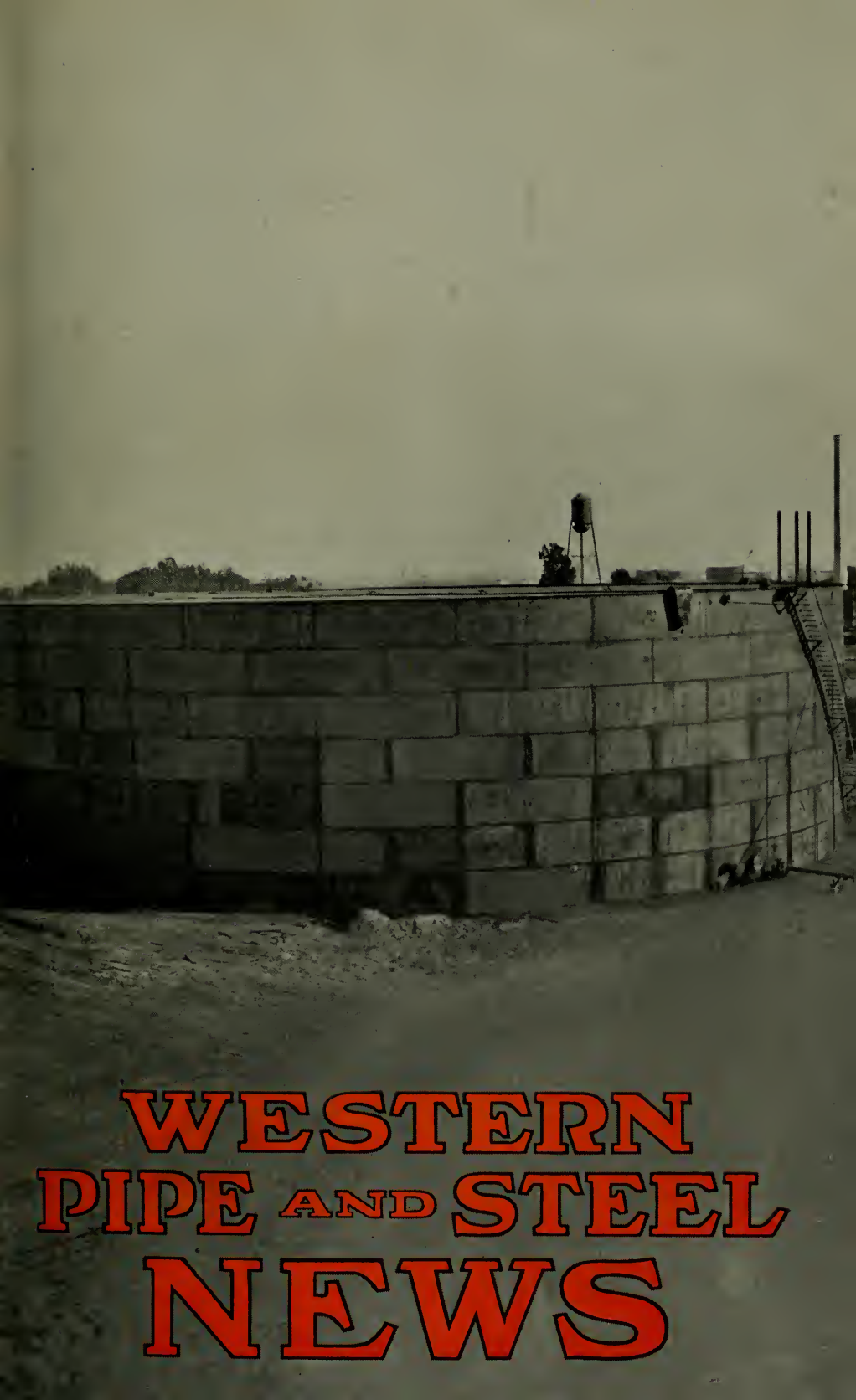
444 MARKET ST.
SAN FRANCISCO

5717 SANTA FE AVE.
LOS ANGELES

FACTORIES

SOUTH SAN FRANCISCO · LOS ANGELES · FRESNO · TAFT · PHOENIX

Designers · Fabricators · Erectors of General Plate Work



WESTERN PIPE AND STEEL NEWS

GENERAL PETROLEUM ADDS FIVE 80,000 BBL. TANKS TO ITS FRUITLAND TANK FARM. *The above pictures show four of the five big tanks recently completed by Western Pipe & Steel for General Petroleum, Los Angeles.*

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME II NOVEMBER, 1925 NUMBER 9

Heavy Over-Production of Oil Starts Big Tank Building Program

By C. M. FULLER

President, Richfield Oil Co.

DEVELOPMENTS in the oil industry during the last eight months have shown how impossible it is to forecast the trend of production over a period of a year. In January, 1925, observers were generally agreed that California's output would continue to fall off from month to month until by the close of the year it would total something less than 15,000,000 barrels monthly. How far off this forecast has gone may be judged from the fact that the state's production for September, the latest month for which complete figures are available, was 20,063,763 barrels.

Present indications are that production in California for the last month of the year will be only slightly below that figure. The bringing in of the Inglewood field and its subsequent surprising showing, has, of course, been chiefly responsible for the increased output. From nothing a year ago, the Inglewood field has come up to 100,000 barrels a day.

The inevitable result of this increase has been that tremendous quantities of oil have gone into storage. The companies which have big production have been hard put to find sufficient tankage for this excess oil, with the result that the state's storage facilities have been greatly increased during the year.

Just when the end of this tank building program will come is difficult to say. The conservative operator does not care to be caught short of tanks, but would prefer to have a slight excess of empty storage for the emergency which is sure to come at not infrequent intervals in the oil business.

There are at present nearly 80,000,000 barrels of heavy crude and fuel oil in storage on the Pacific Coast. We are hopeful that withdrawals during the coming winter months will bring this figure down somewhat, but with the assurance that the state's production, which is now 650,000 barrels daily, will not fall much below that figure before the first of the year, we are not curtailing our tank building program as commenced some months ago. And this may be said to be true, substantially, of the other operators in the field.

Continued increases in heavy crude and fuel oil stocks alone have justified this position. Bureau of Mines figures, covering California for the month of September, show that stocks of these grades of oil increased 3,407,824 barrels during the month and were exactly 26,494,597 barrels higher than they were a year ago. When one considers that this is just half again as much low gravity crude and fuel oil as was in storage a year ago it becomes evident that our storage problem is a tremendous one.

According to the best estimates of those whose business it is to study the statistics of the oil industry, it would seem that, based on known production and known consumption, there will be in California in 1926 an excess of not

less than 25,000,000 to 30,000,000 barrels of fuel oil that will have to go offshore.

This volume will far exceed any deliveries of fuel oil this coast has ever made in the past.

The general situation is, that, while it is true that the total production of oil in the United States is in excess of any figure recorded for a number of years, present production is characterized by a large increase in heavy or fuel oil and a very substantial decline in light or refining oil, thus making the handling of storage for fuel oil almost entirely the pressing problem of the day. Just how soon the pendulum will swing back the other way no one knows or can even guess. It is one of those events that will remain in the realm of uncertainty until it happens.

That is to say, while the present situation in over-production is a complete reversal of conditions that existed two years ago, when the problem was to handle an immense volume of light oil, and consequently gasoline, while now it is running to heavy oil, the conditions of today may be reversed just as unexpectedly as these present conditions themselves arose. Such is the uncertainty of the oil business.

During the tremendous over-production of two years ago, everyone thought that ample storage facilities had been provided for any situation that might arise.

Present conditions merely prove how far wrong those earlier conclusions were.

The oil industry of California is singularly fortunate in having at hand at various strategic points in this state manufacturing plants whose facilities have always proved adequate to the demands made upon them.

Time and again the resources of these manufacturers have been put to the severest test to meet the emergencies that are peculiar to the oil business, and they have always proved equal to the occasion.

Western Pipe & Steel has just completed these four 125,000 barrel tanks for Richfield Oil Company at Hynes, Cal. The cover picture is a close-up view of one of the big containers.

The largest oil storage tanks in the world were built by Western Pipe & Steel at Los Angeles some two years ago to help meet the emergency demand for storage at the time of our greatest period of over-production. They were of 178,000 barrels capacity and the oil world looked on in amazement at the sheer audacity of the undertaking until it was a proven success.

These huge steel tanks were built for the Associated Oil Company, which at that time was forced to provide one million barrels of storage on a given area at its Watson tank farm. Mr. L. D. Jurs, chief engineer of the Associated Oil Company, conceived the idea of building tanks of between 175,000 and 180,000 barrels capacity, or more than twice as large as had ever before been attempted.

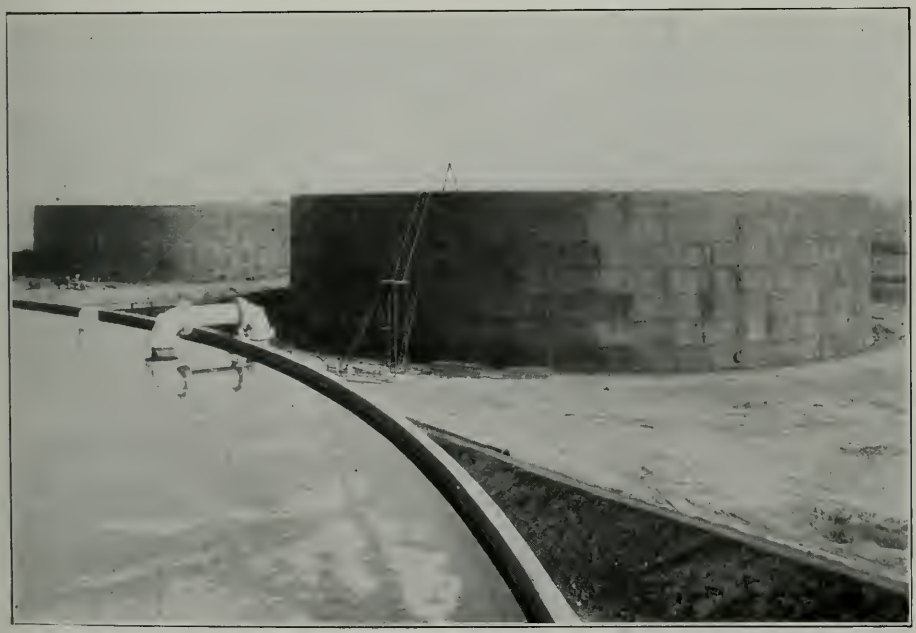
As soon as this decision had been reached, Western Pipe & Steel was called upon to assist in designing them and in planning methods of construction for the job. These tanks were 175 feet, 9 inches in diameter, and 41 feet, 6½ inches high, and held 178,000 barrels of oil. Seven hundred and twenty tons of steel were used in each tank.

The success of this prodigious undertaking has long been well known to everybody in the oil industry. Mr. Jurs, upon acceptance of the big tanks, made the following statement:

"The tanks, when tested with light crude oil upon completion, were freer from shell leaks than any other oil tanks I have ever seen, and were in perfect shape and form during filling and emptying periods. Much credit is due Western Pipe & Steel for the manner in which these tanks were designed, fabricated and erected."

To meet the present situation, Western Pipe & Steel has recently completed for Richfield Oil Co. four 125,000 barrel tanks at our refinery at Hynes.

It is a source of gratification to men engaged in the oil industry in California to know that when it comes to steel storage and other equipment the manufacturing facilities here will be found equal to any emergency that may arise.



This picture shows the world's largest oil tanks—178,000 barrels—described in Mr. Fuller's article. W. P. & S. built them for Associated Oil Co.

THE CAMERA RECORDED WESTERN PIPE & STEEL'S RECORD-BRE

the order was booked for three 80,000 barrel oil tanks for the Watson Tank Farm of C
left hand picture. Forty-eight hours later the bottom of the first tank was in the field
complete, first course on second tank finished, and first course on third tank half finish
shell erected, and third tank well under way. Picture at lower right was taken on thi
entire order was completed forty-seven days after it was booked.

RFORMANCE FOR CALIFORNIA PETROLEUM CORPORATION. *On the day roleum Corp. the steel plates were in stock at our Los Angeles plant, as shown in upper The picture at upper right was taken fourteen days after starting—shell of first tank* LEFT—*Taken on twenty-fourth day—shows first tank all but finished, second tank with y and shows first two tanks completed and third lacking but a few roof plates. The*

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY
of California

444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES

EDITED BY EDWARD F. O'DAY

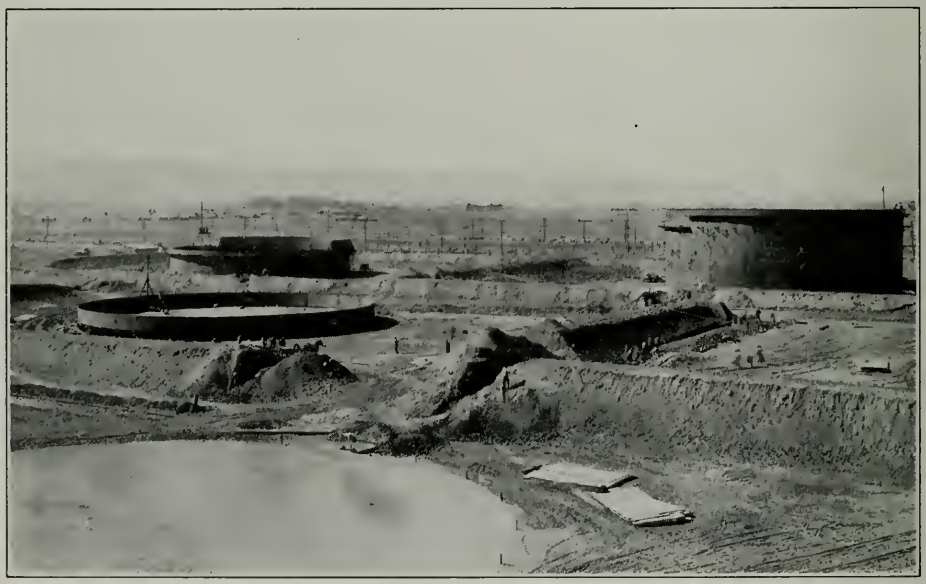
ALTHOUGH very little is heard about it outside of the oil industry, California has been for some time experiencing another period of flush production of oil. The situation is graphically described in the leading article of this issue.

A feature of these periods of overproduction in the oil industry, and one that laymen seldom hear about, is the necessity to which the producing companies are put to provide quickly the required storage facilities.

Speed, of course, is the main essential under such conditions. The importance of saving time is described in an article on the opposite page, which tells of the records broken by this company in building three 80,000 barrel tanks for the California Petroleum Corporation.

As a matter of fact, Western Pipe & Steel has recently completed or is about to complete over 2,000,000 barrels of steel storage tanks in southern California alone. From the best available information we believe that this represents the bulk of all steel storage ordered in this region in recent months. Needless to say, the fabrication and erection of so large an amount of tankage has called forth the utmost resources of our organization. Shop crews and field crews have been on their toes, and with apparently indefatigable energy have time and again achieved what seemed to be the impossible. Because of this spirit, plus the perfection of equipment that characterizes all of the plants of this company, the organization has been able to break its own records repeatedly.

The illustrations in this number of *Western Pipe & Steel News* tell better than words the part this company has played in meeting the present urgent demand for oil storage facilities.



California Petroleum Corp. recently ordered six more 80,000 barrel tanks from W. P. & S. for its Watson tank farm. When this picture was taken four of the tanks—one not shown—were well under way.

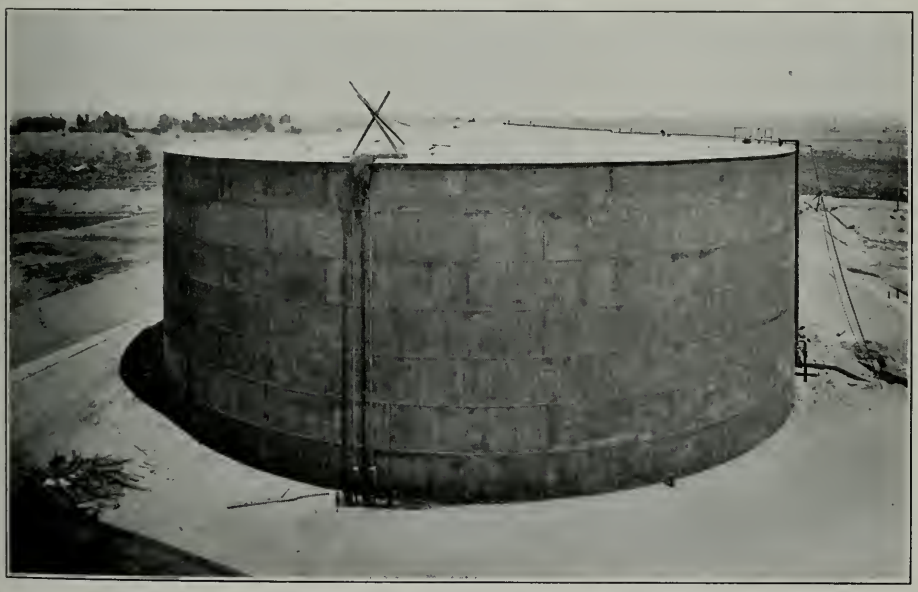
Tanks Built in Record Time

AN 80,000 barrel oil storage tank fabricated and erected in 26 working days, three 80's within 47 days—that is the record made by Western Pipe & Steel shop and field crews on a recent order for the California Petroleum Corporation, Watson tank farm. The meaning of this achievement may be better realized when it is stated that the ordinary time required for completing one 80,000 barrel tank averages from 35 to 40 days.

The order for the three tanks was taken with certain completion dates guaranteed. The first tank was completed five days ahead of time; the second, five days ahead of time; the third, fourteen days; a total on the three tanks of 24 days saved.

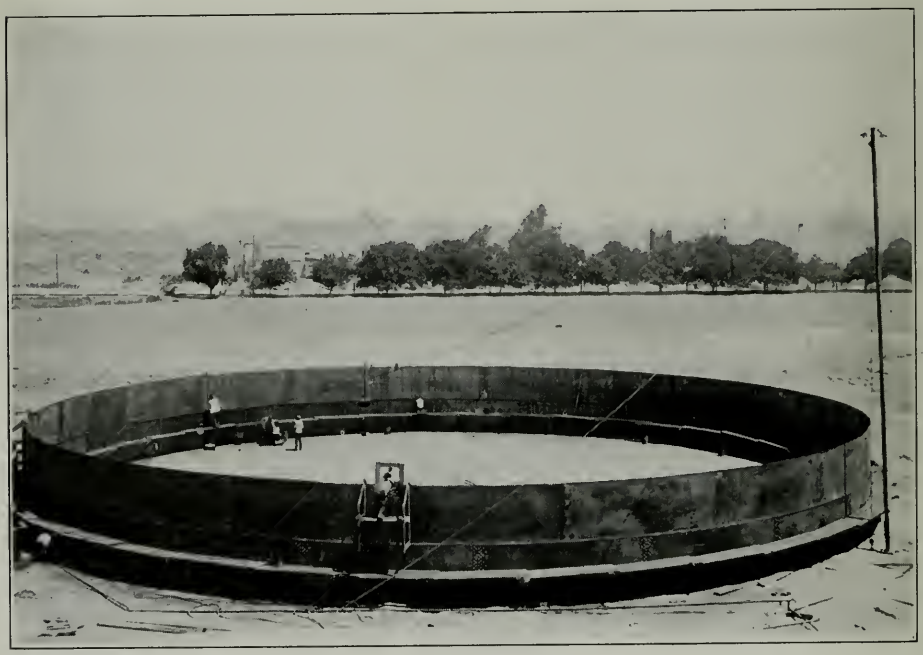
Equipment, organization and morale are the reasons why. The contract was signed at 2 p. m. on a Thursday. Plates began moving into the shop immediately and the layer-out men were busy with templates and chalk. At noon, Saturday—less than 48 hours later—the complete bottom of the first of the three tanks was in the field, sketch plates, bottom angle and all. Twenty-four days later the tank was completed, five days ahead of schedule. The second tank followed, equalling this record. The third tank was to be completed August 24, but it was ready August 10—FOURTEEN DAYS SAVED.

The facts speak for themselves. Western Pipe & Steel more than made good. Which may be one of the reasons why more than 2,000,000 barrels of steel storage, ranging from 10,000 to 125,000 barrels capacity, has been completed or is under way since the records were broken for California Petroleum Corporation.

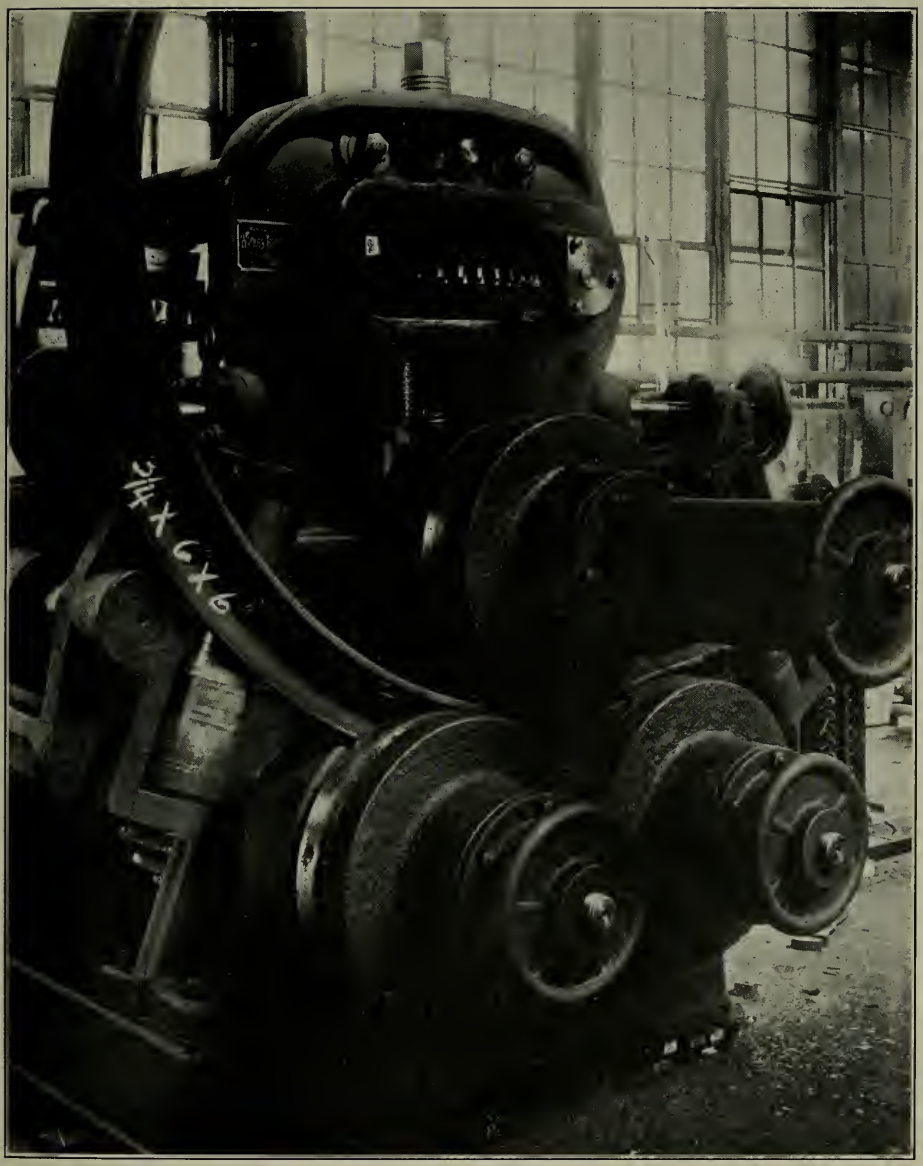


Here is one of the 80,000 barrel tanks described in the article on this page, fabricated and erected for California Petroleum Corp., in record-breaking time.

Bolted tanks for the oil industry are a W. P. & S. specialty. This picture shows two 500-barrel tanks.



This is one of five 80,000 barrel tanks fabricated and erected for General Petroleum Corp. Fruitland Tank Farm. The W. P. & S. field crew is putting the finishing touches on the second course.



A CLOSE-UP OF THE BUSINESS-END OF THE POWERFUL ANGLE BENDING ROLL RECENTLY INSTALLED AT SOUTH SAN FRANCISCO PLANT OF W. P. & S. *This picture was taken while the machine was bending a cold angle six inches by six inches by three-quarters of an inch thick. It enters the rolls straight, but emerges with the curvature shown running up to the upper left-hand corner of the picture. It is not so long ago that forming of heavy materials like this was performed by blacksmith work.*

In the West It's "Western"

With this symbol of craftsmanship Western Engineers, Purchasing Agents, Contractors and other "Buyers of the Best" have come to associate *Quality* in Fabricated Steel Products

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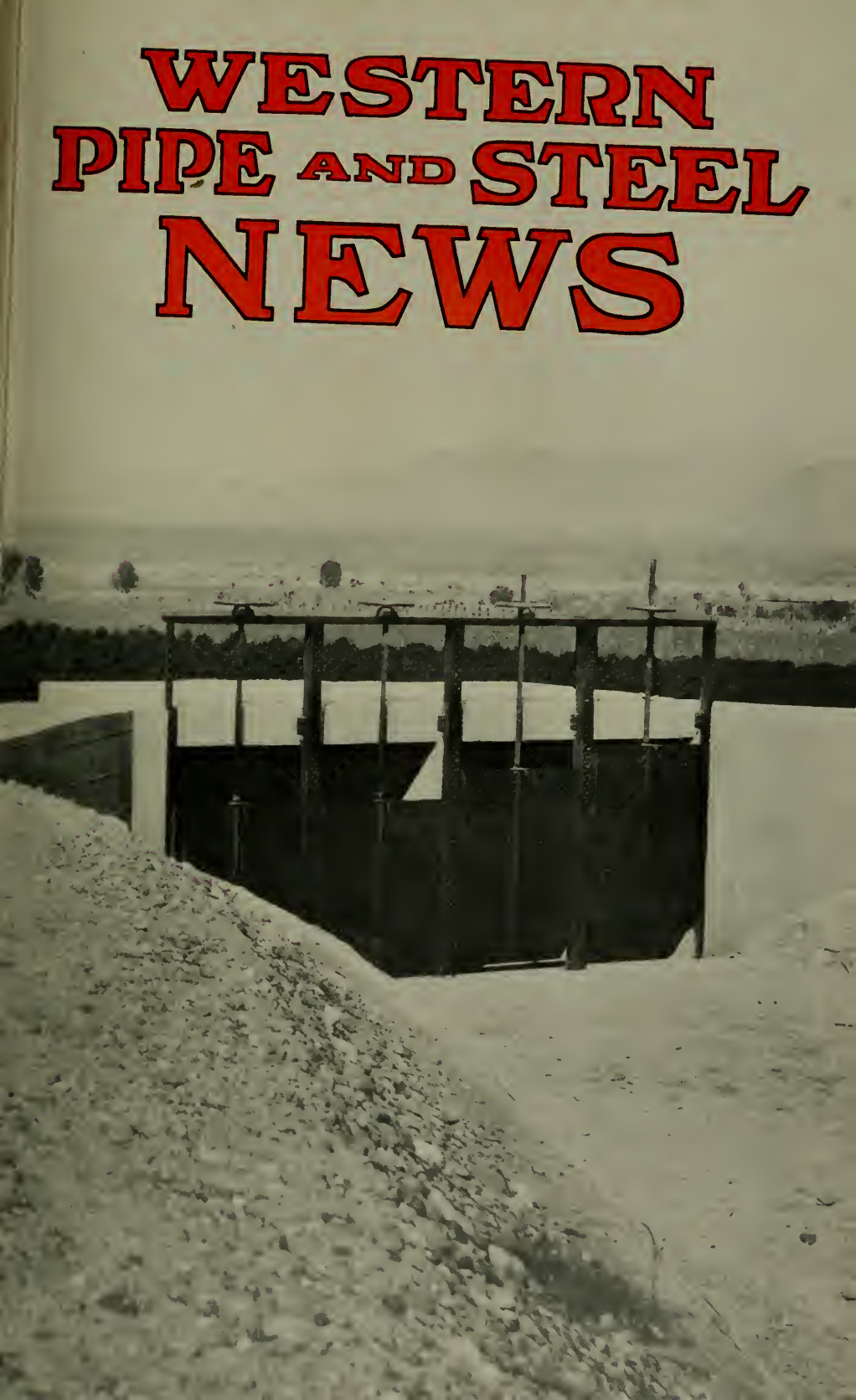
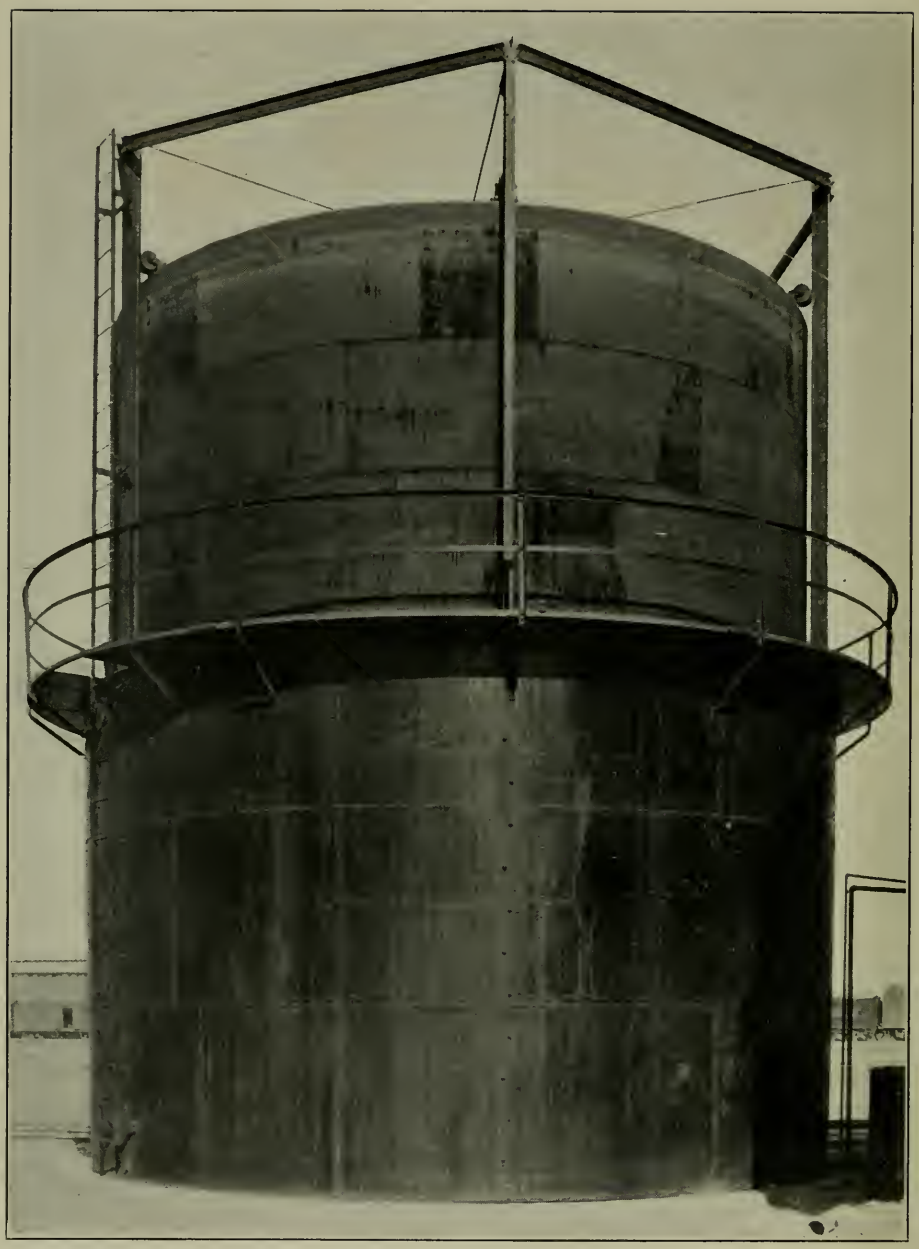
WESTERN PIPE AND STEEL NEWS





A PRODUCT OF WESTERN PIPE & STEEL PHOENIX PLANT.—*Gas holder fabricated and erected for Industrial Chemical Co., Phoenix, Arizona. It is 27 feet in diameter and 34 feet high, capacity 10,500 cubic feet.*

THE COVER PICTURE.—*Typifying irrigation in Arizona as well as the work of our Phoenix plant, the cover of this issue shows one of fifty gates fabricated for Roosevelt Conservation District, Mesa, Arizona, on contract with Jasper-Stacy Co. This view is at pump house where water is boosted to main canal. Each gate is 10 feet high and 42 inches wide. Orange orchard in background.*

Western Pipe and Steel News

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WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME II | DECEMBER, 1925 | NUMBER 10

W. P. & S. Phoenix Plant, an Important Industrial Unit of Arizona

"Phoenix, as a city, is a delightful surprise. It is the business hub of the state and has 1200 thriving business institutions.

"Real estate figures recorded by the city show the assessed valuation on all property within the corporate limits for the year 1924-25 at $47,000,000. The value of county property is assessed at $116,000,000.

"Phoenix enjoys an ideal situation, 1100 feet above sea level, near the Salt River and in the center of the richest and most fertile valley in all America.

"The development of Phoenix is the direct outcome of irrigation. Here arid wastes of desert lands have been reclaimed, cultivated and made profitable, and where once only the cactus grew, wide streets and imposing edifices now mark the progress of business, educational and social life.

"Population in 1910 was only 11,500, as against nearly 40,000 today. Banking conditions, building permits and city valuations all have made rapid and sustained progress, and Phoenix today is the largest city between El Paso and Los Angeles and the most important city of the Colorado River Basin."

BACK in the days when Phoenix—now the busy metropolis and capital of a state two-thirds the area of California—was little more than a promising small town, some of her forward-looking citizens began to vision a time when, through the miracle of water, the vast desert spaces of Arizona would be transformed into green farms and blooming gardens. Some saw even farther. They believed that after the deluge of life-giving water, would come a commercial and agricultural empire whose potential richness would astound the world.

It required no clairvoyant powers to foresee these things, but rather, sound common sense looking at the future through the glasses of faith. That faith has been more than justified; the visions have come true; the dream is reality.

Today, less than two decades after the inception of the great Roosevelt Irrigation Project, the Salt River Valley of Arizona is a veritable garden spot. Roosevelt Dam, the keystone of this huge project and the world's second largest dam, was completed so late as 1911, and yet since that year Phoenix has grown from a town of 11,000 to a bustling city of 40,000; 245,000 acres of land that was for thousands of years a forbidding desert have been placed under irrigation; and sufficient electrical energy is being developed to care for many times the needs of the present situation.

By 1920 the business of Western Pipe & Steel in this territory had attained such volume that the management of the company decided the time was ripe to establish a manufacturing plant at Phoenix. Prior to this time orders for the

various products of the company, such as well casing, water pipe, galvanized corrugated culverts, surface irrigation pipe, tanks of all kinds, smoke stacks, and general sheet and plate work, had been filled from the Los Angeles plant.

Since the decision was made to bring its manufacturing facilities into more intimate contact with Arizona customers, the plant has developed into one of the major industrial units of Phoenix.

And so this number of Western Pipe & Steel News has been specially planned to broadcast information regarding the activities and facilities of our organization there. The quotation at the head of this article gives an impressive picture of conditions in Arizona. It was taken from a booklet issued by the Phoenix Arizona Club entitled: "Phoenix, Arizona, Where Winter Never Comes."

Without attempting to give a lengthy summary of the manufacturing activities of Western Pipe & Steel in Arizona since the establishment of the Phoenix plant in 1920, a short survey of the year just ending may be of interest. At any rate it will serve to create in the minds of our readers a picture of what we are doing.

With reference to the Salt River Valley Irrigation Project, it may be stated that this organization is controlled and operated by the Salt River Valley Water Users Association, a public corporation whose function is to deliver irrigation water to the land, and to develop and maintain hydro-electric energy for this region.

During 1925, Western Pipe & Steel Phoenix plant supplied all water well casing used by the Salt River Valley Water Users Association. The casing for the entire water well program of the Roosevelt Conservation District at Mesa, Arizona—20 wells in all—was also supplied by our Phoenix plant. The same is true of the Pima Farms Company at Cortaro.

General view of Western Pipe & Steel Plant at Phoenix, Arizona. Note diversity of products, including culverts, well casing, water pipe, structural steel, tanks, etc.

Going a little farther afield, the Phoenix plant is now engaged on a contract with the Hudspeth County Conservation and Reclamation District No. 1 at Fort Hancock, Texas, for furnishing water well casing for 30 wells for their drainage system.

Next to well casing in rank of output during 1925 was galvanized corrugated culvert pipe. On one order alone the Phoenix plant supplied twenty-two carloads of culverts for the Prescott-White Spar Highway, the famous scenic highway between Prescott and Phoenix.

It may be said in passing that for the last three years W. P. & S. Phoenix plant has supplied practically all culvert pipe installed by the Arizona Highway Department. These culverts, of course, were fabricated from the famous Keystone copper steel galvanized corrugated culvert sheets, the same as this company has been supplying all along the Pacific Slope for years.

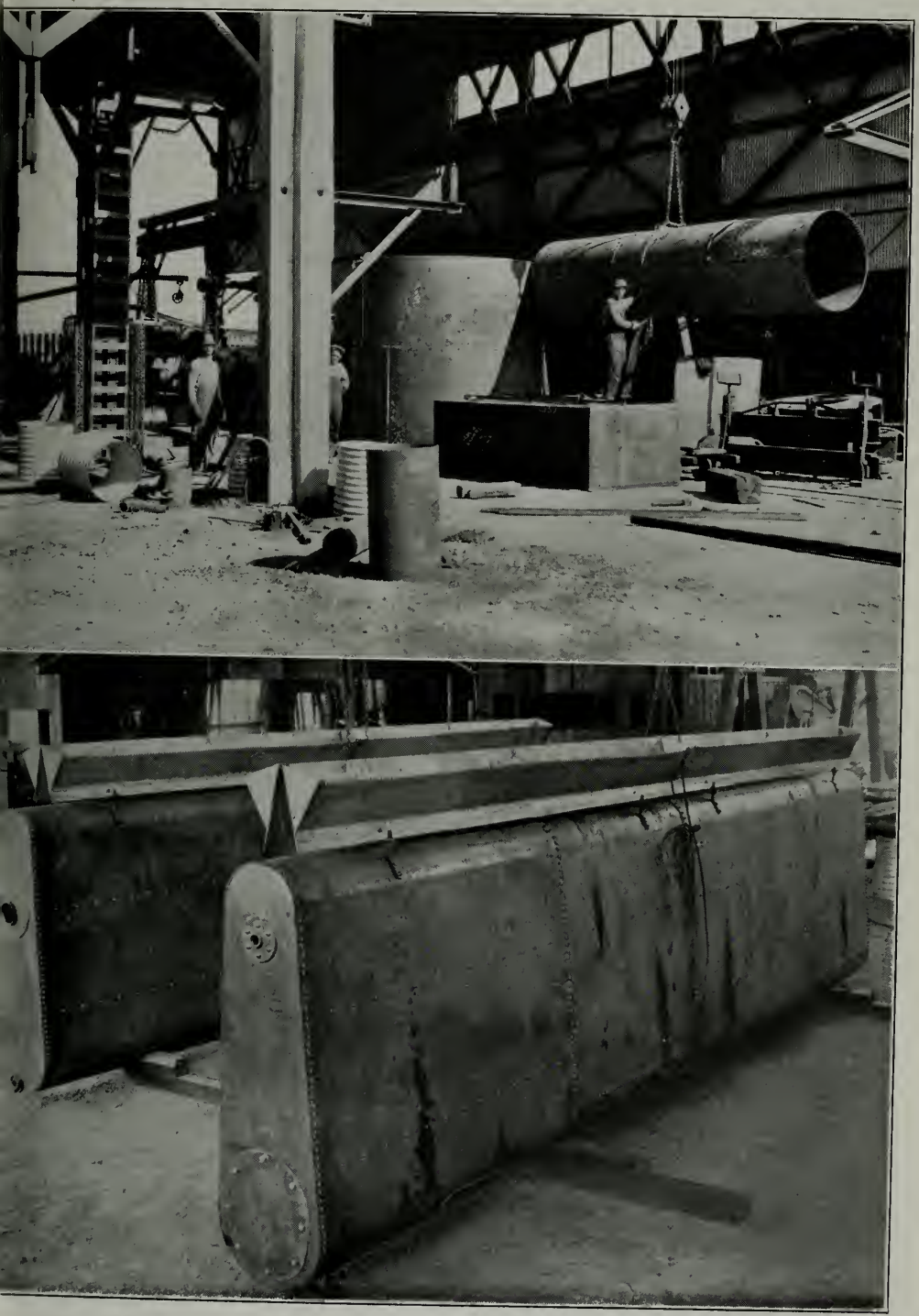
Needless to say the same superior qualities of rust-resistance exhibited by this copper-bearing metal elsewhere are in evidence in the same degree in this region. As culvert experts, it is our experience that no other metal can, under any conditions, equal Keystone copper-bearing steel in strength, long life, and resistance to corrosion.

We are proud to be able to say that culverts fabricated of this superior metal are playing an important part in the great highway program going forward in Arizona.

Among other important products of the Phoenix plant may be listed water pipe, storage tanks of all kinds, including black steel tanks, bolted, riveted and welded; galvanized tanks, both corrugated and straight side; smoke stacks, irrigation gates, gas holders, trailer dump bodies, and a full line of screens for rock crushing plants up to 7/16-inch plate. Also Fresno scrapers complete, together with a full line of all styles of Fresno parts.

Installation of steel brine tank fabricated for York Products Co. at Crystal Ice & Cold Storage Co., Phoenix. Tank is 79 feet 7½ inches long; 20 feet 10 inches wide and 4 feet 10½ inches deep.

SHOP VIEWS TAKEN AT PHOENIX, ARIZONA, PLANT OF WESTERN I
teristic of Phoenix as well as all other Western Pipe & Steel plants. UPPER LEFT—*Fabri*
oil storage tanks, air receiver and dip tank in process of fabrication. LOWER LEFT—*Lookin*
eral plate work. LOWER RIGHT—*These 21-ton condensers were designed and fabricated fo*



STEEL.—*Wide diversity of products fabricated from steel sheets and plates is charac-*
as purifiers, scrubbers, etc., for Mesa, Arizona, Gas plant. UPPER RIGHT—*This view shows*
gh main shop at Phoenix plant. Note well casing, galvanized tank, steel tanks and gen-
Dairy & Ice Co., Mesa, Arizona. They are made of 3/16-inch steel plates.

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THE management of Western Pipe & Steel Company takes pleasure in presenting its compliments to customers and friends through the medium of a calendar for 1926. It was sent out just after the Christmas mail rush and should be in the hands of addressees by this time.

Aside from its utility—and what office does not like to receive a simply designed, legible calendar—we believe our new calendar will be found pictorially interesting by engineers, purchasing agents and other buyers of products fabricated from steel.

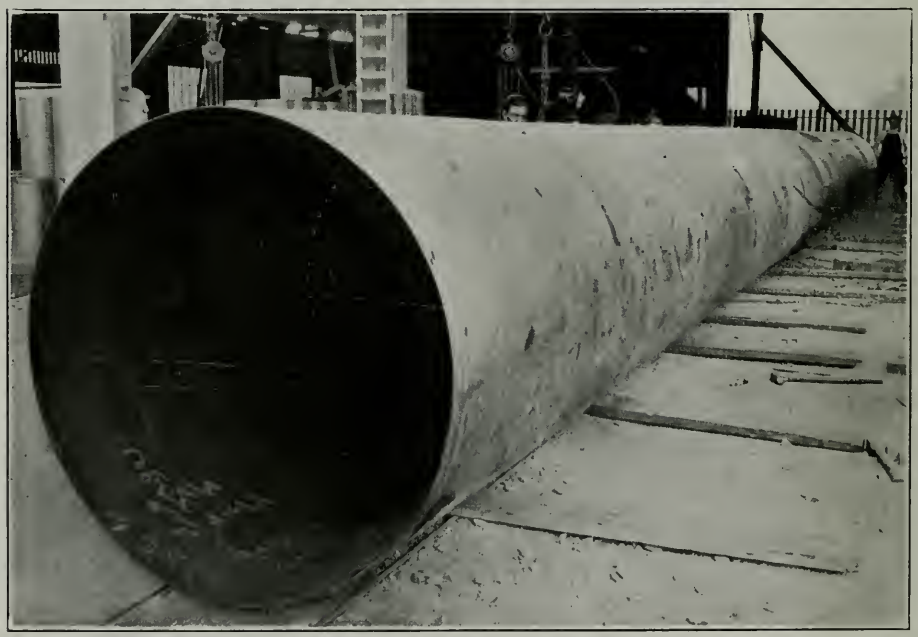
It is one of the privileges of our business to encounter all sorts and conditions of work, large and small, and it is our policy to let the camera record progress and completion on work for which this company supplies material.

And so during the course of a twelve-month, we acquire a pictorial record of work all along the Pacific Coast which discloses a variety of subjects, scenery and location perhaps not duplicated elsewhere in this country.

In planning an advertising souvenir for our friends such as this calendar, the problem was one of elimination rather than selection. It was harder to determine what to leave out than what to include. Having but twelve calendar pages, it was finally decided that a wide variety of products should be featured and that the illustrations used should have an appeal broad enough to claim the interest of technical men and laymen alike.

Among the subjects illustrated will be found water pipe, galvanized corrugated culverts, oil storage tanks, lock-bar pipe, absorption towers, bolted tanks, penstocks, soil-proofed pipe, structural steel, etc.

Anyone interested in having this calendar is cordially invited to write to W. P. & S.



Western Pipe & Steel Phoenix Plant fabricated this huge smokestack for Tucson Gas & Electric Co., Tucson, Arizona. Smokestack is 60 feet high and 73 inches in diameter.

Transporting Concentrates by Pipe Line

By E. Weber
Purchasing Agent, Magma Copper Co., Superior, Arizona

WHAT is believed to be an entirely new and unique method of transporting concentrates from mill to smelter, is that employed by the Magma Copper Company at its plant at Superior, Arizona. The smelter, which started operations in March, 1924, represents the most up-to-date equipment and design in modern smelting practice. Its maximum capacity is 4,000,000 pounds of copper bullion (blister copper) per month.

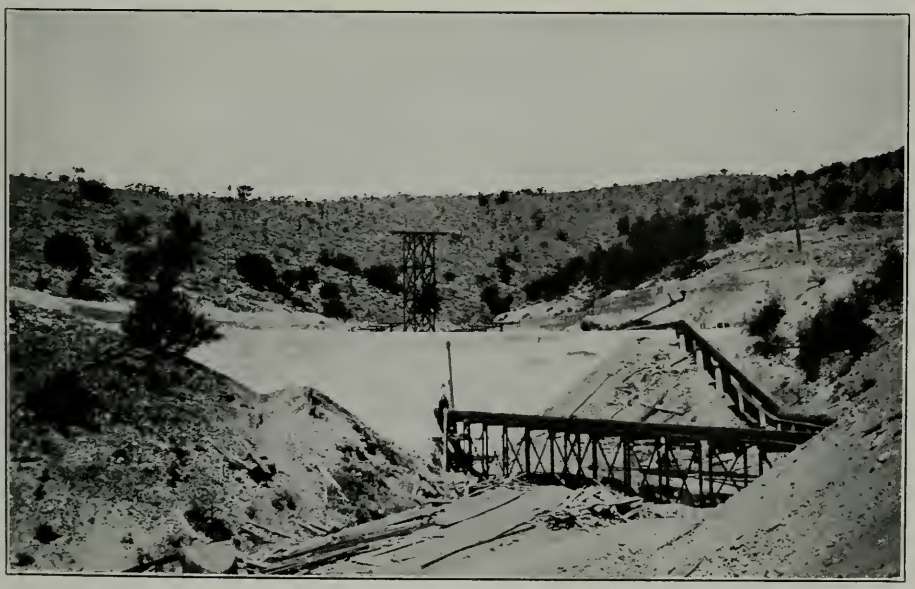
Under present curtailed conditions of production at the mines the output is 2,250,000 pounds per month. Both "crude" ore and mill concentrates are handled, of 6% average copper content. The "crude" is hauled from the mine to the receiving bins in hopper-bottom standard-gauge gondolas.

The concentrates are pumped from the mill (concentrator) a distance of one-half mile, through a 36-inch diameter pipe line. The material pumped has a consistency of about 65% solids.

The cut on this page was made from a photograph taken specially to illustrate this article. It shows the installation of the steel circulation pipe at the cooling pond at our smelting plant. Western Pipe & Steel not only fabricated the pipe but installed it as well.

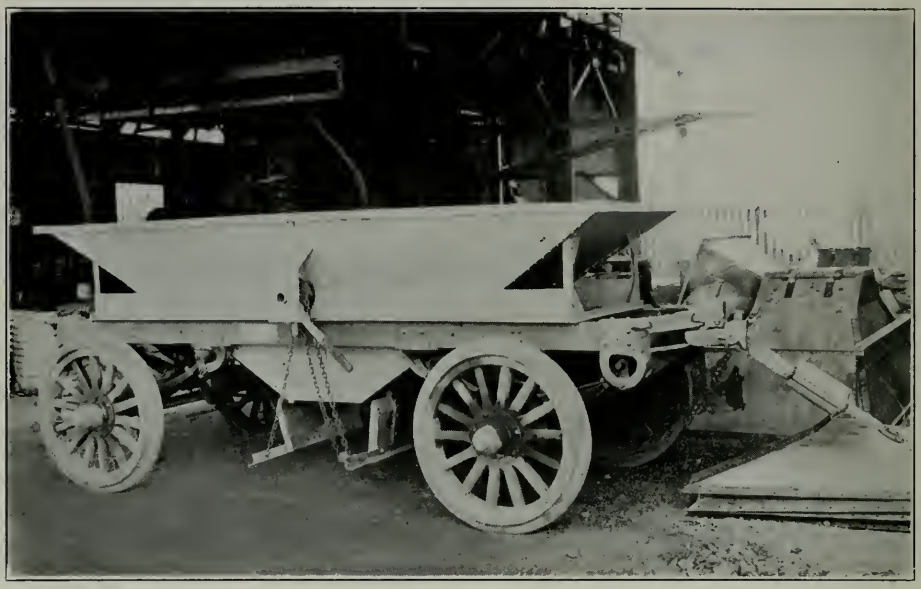
The line, in spite of the unusual character of the service required of it, is eminently satisfactory, which speaks volumes for the manufacturing methods of Western Pipe & Steel, and for their field service.

The plant is served by broadgauge railroad spurs, has a power house with two 1500-kw. turbo-generators, one 12,000 cubic foot steam-driven blowing engine, two 150-kw. motor-generator sets, and a 13-panel switchboard. Each turbine is provided with surface condenser. The smoke stack is 300 feet high above the concrete foundation. There is also a machine shop, fully equipped, a warehouse, fuel oil storage, and so forth.



Installation at Cooling Pond of 36-inch circulation pipe fabricated and installed by Western Pipe & Steel for Magma Copper Co., Superior, Arizona, described in article above.

For Arizona Highways



This trailer dump body, of 2½ yards capacity, was designed for Arizona State Highway Department for use in highway construction work, and is fabricated at our Phoenix plant in large numbers. This is one of our contributions to Arizona's good roads program.

Loading out culvert pipe for Arizona Highway Department at Phoenix Plant of Western Pipe & Steel. View shows culvert sections being placed on flat cars by over-head traveling crane. For the last three years, Western Pipe & Steel has furnished practically all culverts for the Arizona State Highway Department.

FABRICATED AT PHOENIX.—*These twin smokestacks for the Central Arizona Light & Power Co., at Phoenix, were fabricated and erected by Western Pipe & Steel. They are 74 feet in height and 60 inches in diameter.*

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WESTERN PIPE AND STEEL NEWS

DETROIT INSTALLS LOCK-BAR PIPE.—*This picture was taken in Detroit, Mich., a few weeks ago. It shows how Lock-bar 48" diameter steel pipe was laid along Hancock street. The pavement is disturbed very little for pipe of such magnitude.*

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME III JANUARY, 1926 NUMBER 1

Western Pipe & Steel Co. to Manufacture Lock-bar Steel Pipe

THE special attention of engineers, purchasing agents and public officials in the West is respectfully directed to this number of WESTERN PIPE & STEEL NEWS, which carries an announcement of unusual interest, viz.: the entrance of Western Pipe & Steel Company into this field as manufacturers of Lock-bar steel pipe. Arrangements have been completed with the East Jersey Pipe Company of New York, which has controlled the manufacturing rights of Lock-bar pipe in this country for the past twenty-one years, and, with the installation of special equipment, Western Pipe & Steel is prepared to give buyers of Lock-bar pipe all of the service and advantages that accompany local manufacture.

In its broader aspects, this means that Western Pipe & Steel is now in a position to render to its customers a new and most unusual service. In the future, whenever a problem concerning a water project is presented, the fact that this company is now equipped to manufacture Lock-bar steel pipe as well as electric welded and riveted steel pipe, means that it can offer its customers the most economical type of pipe for that particular project, with no possibility of having to advance an inferior type of construction to meet competition.

In other words, Western Pipe & Steel is henceforth in a position to advocate the type of construction best suited to the particular conditions of each individual project, no matter what they may be. The varying problems that always arise in connection with projects for the transmission of water by pipe line, are familiar to every engineer.

Experience gained in hundreds of installations over a period of nearly a quarter of a century, demonstrates conclusively that Lock-bar pipe is above comparison for efficiency, durability, and strength, on a majority of projects where the size of the line is from 24″ to 72″ diameter.

This does not mean that the superiority of the Lock-bar design has universal application. Projects will arise from time to time, where, by reason of conditions peculiar to that particular plan, electric welded pipe will be found appropriate. On the other hand, under certain circumstances, riveted steel pipe will prove to be the most desirable.

What we desire to emphasize especially to our friends of the engineering profession, is that our own experts now stand ready to assist in the study and analysis of the local conditions peculiar to any project for the transmission of water from the manufacturing standpoint, and to confer and advise with them as to the most desirable and practical type of steel pipe.

The illustrations presented herewith should be of interest, for they show not only some of the more important installations of Lock-bar pipe made in various sections of the United States, but also some important technical details.

Particularly informing is the cut on page eight showing the results of some of the pulling tests made recently with test bars cut from sections of Lock-bar pipe forty inches in diameter, made of quarter-inch plate. These pulling tests, which prove conclusively that, though the plate may give way, the Lock-bar joint will hold, were conducted in the presence of a number of eminent Pacific Coast engineers.

That these men were forcibly impressed by the remarkable showing of the Lock-bar joint goes without saying. Technical men everywhere marvel at the astounding performance of a pipe joint that holds perfectly while the steel plate is pulled to a point of elongation where it must perforce give way. Details covering these pulling tests will be found to accompany the illustration referred to.

Lock-bar pipe is not new. Since 1905 more than 400 miles of Lock-bar steel pipe have been manufactured and installed in the United States and Canada.

One of the most notable installations is that recently completed for the City of Portland, Oregon, whose entire water supply is now entrusted to Lock-bar steel pipe. This installation, known as Bull Run conduit No. 3 (the second installation of Lock-bar for this city), consists of 25 miles of 50″ and 58″ diameter Lock-bar steel pipe.

An interesting feature of Portland's installation is that while the engineer's estimate was for a delivery of 63,000,000 gallons of water per day, tests have shown an actual delivery of 74,000,000 gallons per day.

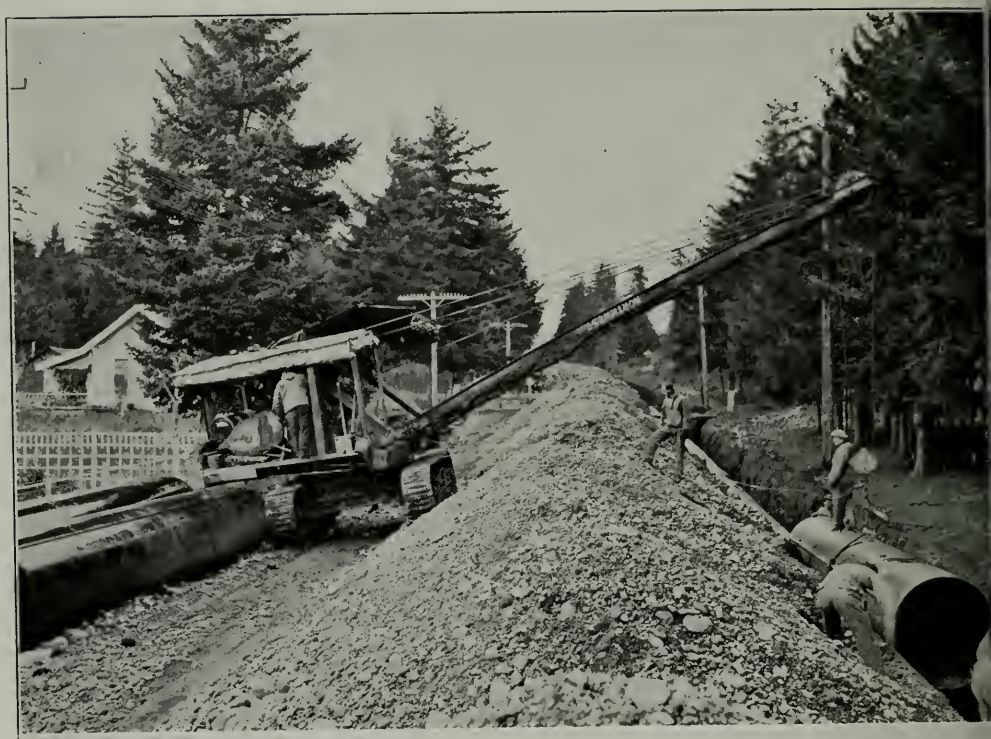
An excellent illustration of the appearance of the longitudinal seam in Lock-bar Pipe. Photo shows 60″ and 48″ diameter Lock-bar ready for installation in the City of Detroit, Mich.

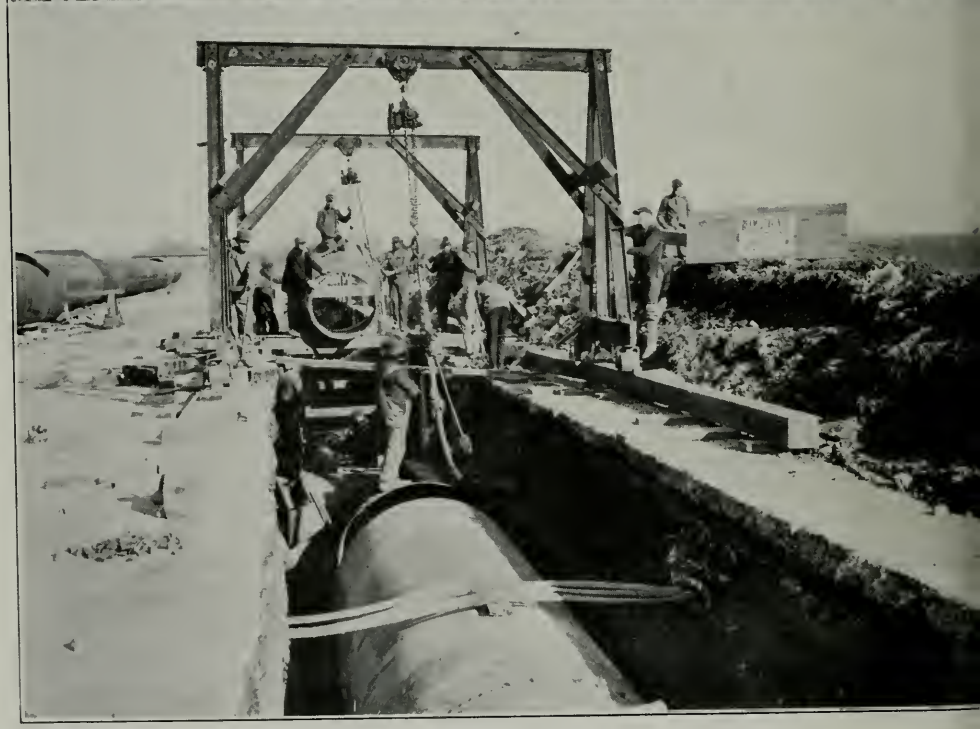
Among other installations of Lock-bar pipe in the past five years may be noted the following, in reverse chronological order:

Location	*Diameter*	*Footage*
1925		
Boston, Mass.	56" & 60"	18,420
Cleveland, Ohio	36", 42", 48"	29,791
Detroit, Mich.	42", 48", 60"	41,969
Philadelphia, Pa.	36"	10,294
B. W. S. Brooklyn	72"	14,360
Montreal, Canada	48"	11,000
Omaha, Neb.	48"	22,000
1924		
Kearny, N. J.	30"	7,800
B. W. S. Brooklyn	72"	11,098
Boston, Mass.	56" & 60"	25,829
Philadelphia, Pa.	48"	9,575
Cleveland, Ohio	48"	6,502
1923		
Cleveland, Ohio	60"	10,400
B. W. S. Brooklyn	66" to 72"	16,800
Detroit, Mich.	24"	7,800
B. W. S. Brooklyn	66" to 72"	41,430
Kearny, N. J.	30"	5,600
Elyria, Ohio	36"	1,400
1922		
Cleveland, Ohio	60"	20,000
Montreal, Can.	48"	11,000
Montreal, Can.	36"	2,000
Detroit, Mich.	36"	5,000
Bay City, Mich.	48"	4,000
1921		
Detroit, Mich.	48"	13,000
Saginaw, Mich.	36"	5,000
Detroit, Mich.	48"	6,000
Philadelphia, Pa.	36"	1,000
Philadelphia, Pa.	60"	7,000
Philadelphia, Pa.	72"	2,500

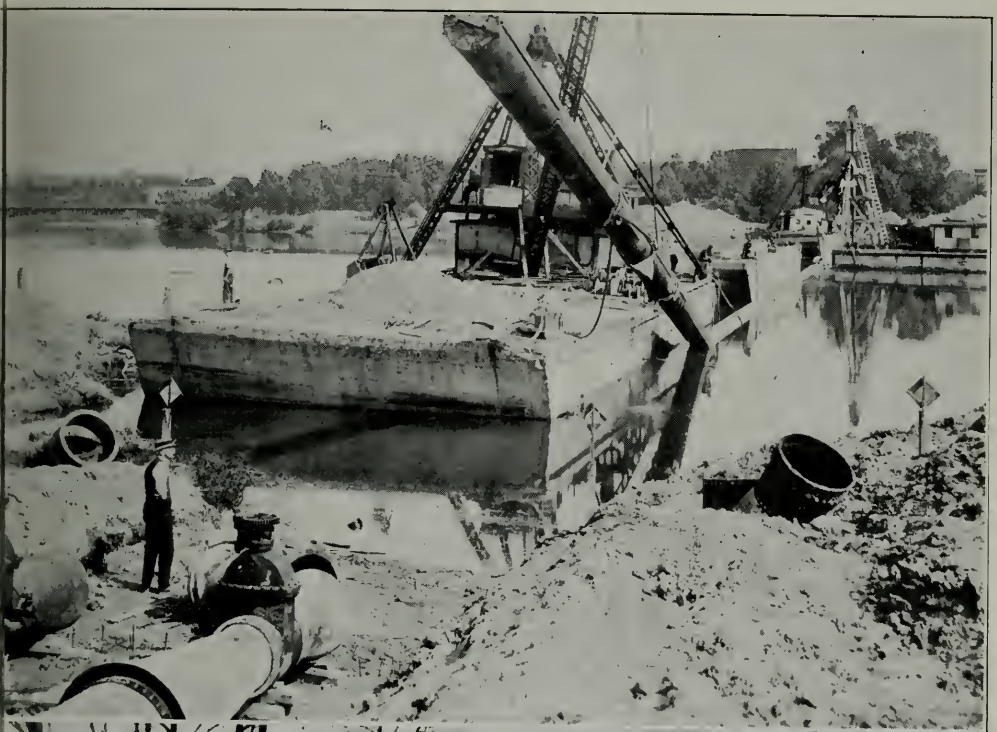
Some of the more notable installations of Lock-bar steel pipe prior to 1921 were made in the following localities: Salt Lake City, Rochester, N. Y., St. Louis, Mo., Bayonne, N. J., Akron, Ohio, Elyria, Ohio, Jersey City N. J., Ottawa, Ontario, Winnipeg, Minneapolis, Omaha, Seattle, Montreal, Springfield, Mass., Philadelphia, Pa., Lockport, N. Y., Wilmington, Del., Trenton, N. J., Vancouver, B. C., Brooklyn, N. Y., and Schenectady, N. Y.

This action picture of Lock-bar installation was taken recently when the City of Portland, Oregon, was putting in 25 miles of 50" and 58" Lock-bar steel pipe on Bull Run Conduit No. 3.





INSTALLING LOCK-BAR STEEL PIPE UNDER VARYING CONDITIONS.—*Run Conduit No. 3. The pipe is 50" in diameter, plate 5-16" thick.* UPPER RIGHT.—*In in submarine lines.* LOWER LEFT.—*For the Torresdale line, Philadelphia, Pa., 7,000 fee merely a question of proper field equipment.* LOWER RIGHT.—*Boston's Metropolitan three contracts in the last two years. This picture, taken near Waltham, Mass., sho*



FT.—*This scene shows field crew laying Lock-bar pipe for City of Portland, Oregon, Bull of 36" Lock-bar pipe across a river, City of Saginaw, Mich. Lock-bar is frequently used ock-bar steel pipe was installed in 1921. Handling pipe-sections of such huge diameter is ommission is a heavy user of Lock-bar steel pipe, having installed over 43,000 feet on se of making long radius curves through the girth joints.*

Western Pipe and Steel News
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of California
444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

WITH its new South San Francisco plant rapidly nearing completion, Western Pipe & Steel will very shortly be ready to begin the manufacture of Lock-bar steel pipe. The illustration on this page shows the status of construction work a few days ago. By the time the building is completed, the equipment for manufacturing Lock-bar pipe will have been installed. The new building will rank as one of the largest industrial units in the West. It is 1240 feet long by 80 feet wide. The height from the ground to the crane rail is 45 feet.

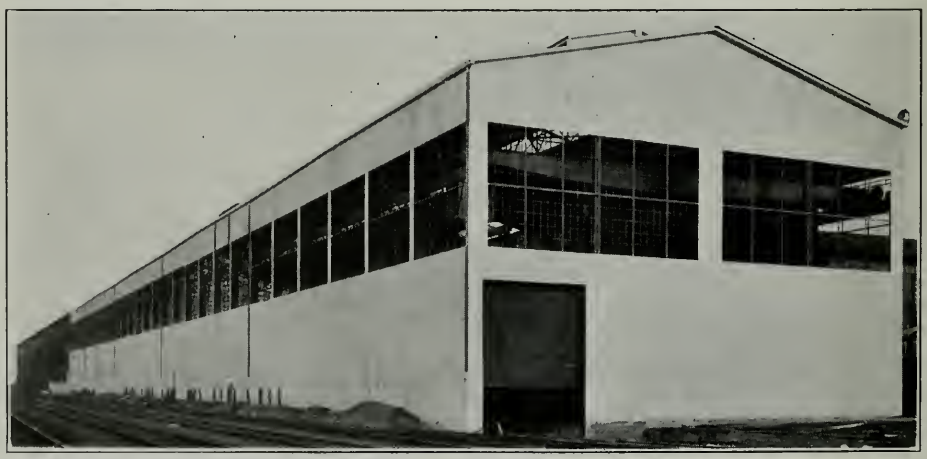
Although the enlarged plant was planned primarily for the installation of equipment for the manufacture of Lock-bar pipe, other material will be fabricated here as well, such as steel tanks for all purposes, structural steel, and general plate work. It is worthy of note that all of the structural steel for the new plant was fabricated by Western Pipe & Steel at South San Francisco.

We take particular pride in announcing ourselves as manufacturers of Lock-bar steel pipe for the Pacific Slope. Many of the most important pipe line installations in this country and Canada in recent years have been Lock-bar, and engineers are virtually unanimous in pronouncing it the ideal type of steel pipe construction.

One of the most notable Pacific Coast installations, and one with which most Western engineers are familiar, is that of the City of Portland, Ore., which, with the completion of the line known as Bull Run Conduit No. 3, has entrusted its entire water supply to Lock-bar pipe. This line consists of 25 miles of 50″ and 58″ diameter Lock-bar steel pipe.

* * *

THE COVER PICTURE.—The illustration on the cover of this issue is from a photograph of the installation of 58″ diameter Lock-bar pipe for the City of Portland, Ore. This line is known as Bull Run Conduit No. 3, and consists of 25 miles of Lock-bar steel pipe. Daily capacity, 74 million gallons of water.



Here is a progress picture of the new W. P. & S. Plant at South San Francisco, designed for the fabrication of Lock-bar Pipe as well as other products made from steel plates.

Lock-bar Pipe

LOCK-BAR PIPE is made in sizes ranging from 24″ to 72″ in diameter, and thicknesses from 3-16″ to 1-2″ inclusive. One of the salient features of Lock-bar pipe is its additional carrying capacity over riveted pipe of the same diameter, due to its smooth interior surface. Lock-bar pipe will carry between 10% and 15% more water than riveted pipe of the same diameter. On new pipe this percentage will be even greater.

All Lock-bar pipe is made up in sections approximately 30′ long so that the number of field joints is kept at a minimum. The field joints are usually riveted lap joints. Each pipe section is slightly tapered, so that the small end of one section fits easily into the larger end of the adjacent section. In this way fitting up in the field is accomplished without difficulty.

Angles up to 5 degrees may be taken in the pipe joints by proper manufacturing in the shop. On long radius bends, short pipe sections may be made up and a series of 5 degree angles may be taken in the successive joints, thus taking care of a sharp change in direction without the necessity of making up riveted specials.

All sections of Lock-bar pipe are hydrostatically tested in the shop to at least one and one-half times the working pressure to which the pipe will be subjected in service, so that field caulking is unnecessary except at the field girth seams.

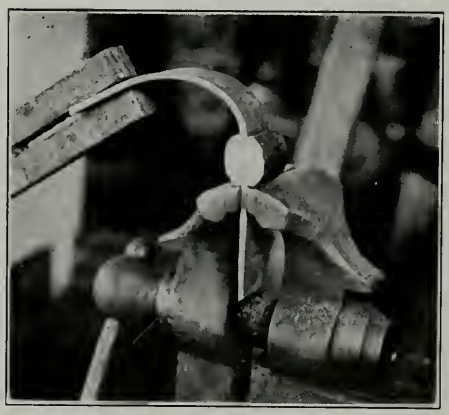
Due to the smooth exterior surface of the Lock-bar pipe it is easily wrapped with soil-proof coating and the coating will be extremely smooth and serviceable when applied to this type of pipe.

Lock-bar pipe is also coated with dip by pre-heating the pipe in an oven to the temperature of the dip and vertically dipping the pipe in the coating. In this way a very smooth coating is obtained and the coating adheres to the pipe to best advantage through this method of applying.

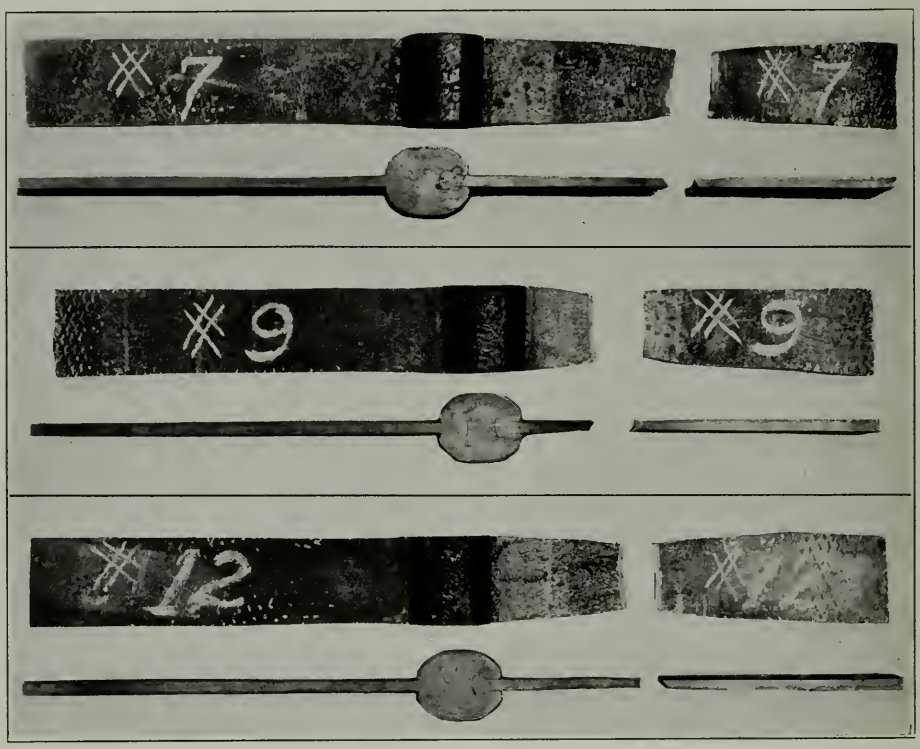
The bars used in manufacturing Lock-bar pipe are carefully designed to obtain a cross section which will give them sufficient strength to develop a 100% joint at all times.

At the start of the operation the plates are up-set along the edge with a sufficient amount of up-set to insure a shearing surface large enough so that the pipe will fail at the plate before the bars will shear the up-set edge. The bars are then designed with sufficient cross-sectional area so that the stress due to bending momentum on the bar will always be less than the stress in the plate itself, and therefore the bars can never open up due to bending. This type of design makes Lock-bar pipe 100% efficient at the joint.

Due to the perfection of manufacturing methods, Lock-bar pipe in large quantities can be made in a reasonably short length of time, and for this reason deliveries can be made very rapidly.



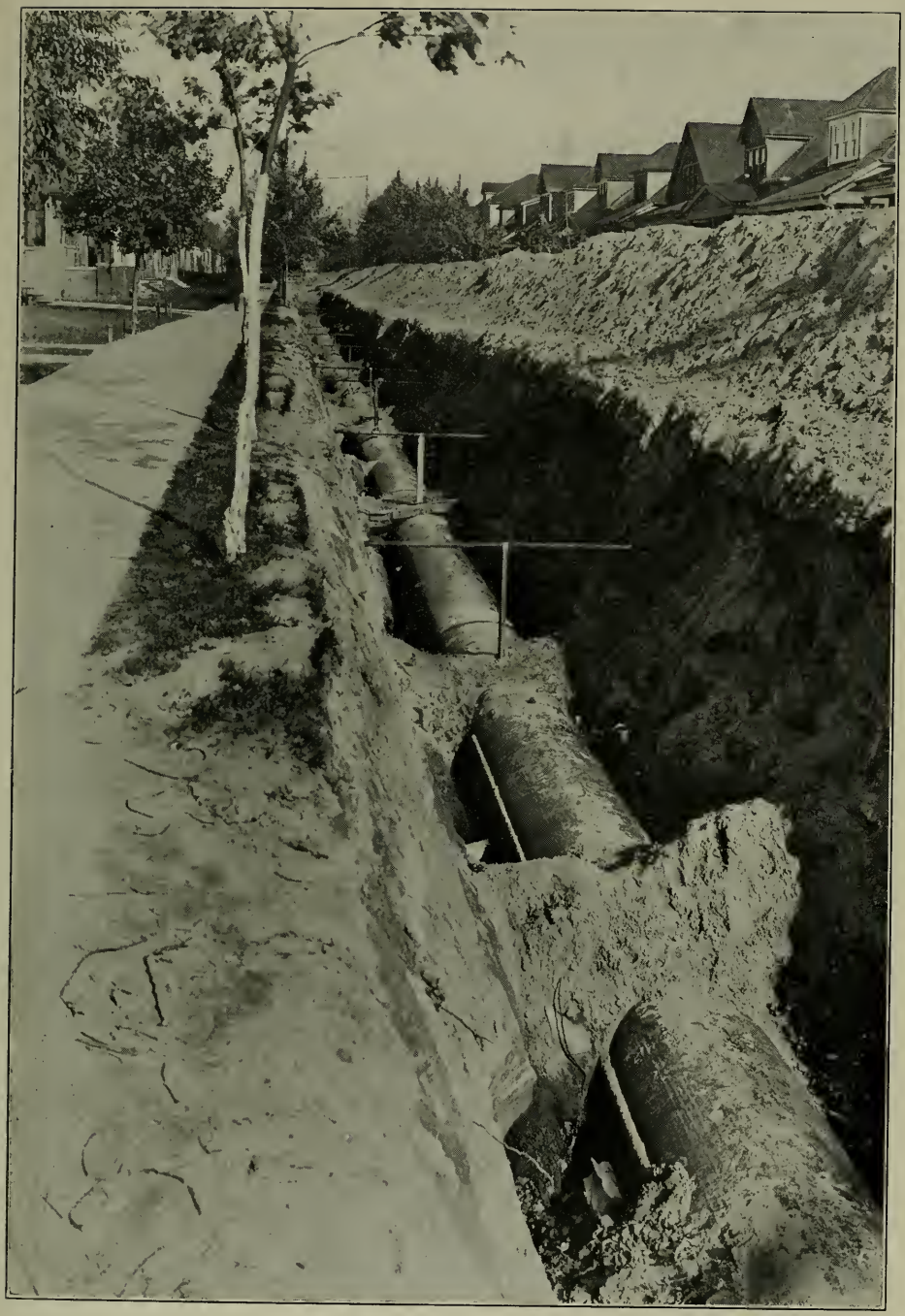
Close-up of bending test on Lock-bar joint. The joint holds tight.



Tests of Lock-bar Steel Pipe Joints

Number of Test	Section Width	Section Thickness	Area Sect. Sq. In.	Reading Elastic Limit	Reading Tensile	Per Sq. Inch Elastic	Per Sq. Inch Tensile	Joint Eff. %	Remarks
a	1.9"	¼"	.475	18,000	29,950	38,000	63,100	115+	Flange steel
b	2.004	¼"	.501	18,200	29,980	36,320	59,850	109+	do
7	2.0	¼"	.5	.....	30,030	.....	60,060	110+	do
9	2.0	¼"	.5	17,320	29,980	34,640	59,960	109+	do
9a	2.0	¼"	.5	.....	31,030	.....	62,060	113+	do
12	2.0	¼"	.5	18,000	29,960	36,000	59,920	109+	do

The above tests were made in the presence of F. A. Rhodes, City Manager of San Diego, T. A. Mills, Assistant Engineer, and J. B. Lippincott, Consulting Engineer, at the Pacific Coast Steel Company's shops, South San Francisco, January 29, 1926. None of the breaks of the Lock-bar pipe occurred at the joints. The "joint efficiency" is determined here by dividing the tension shown by the specified strength of the steel plate of 55,000#. The illustration above shows test bars Nos. 7, 9, and 12, which were set up and photographed following the pulling tests. These tests were made on bars actually cut from Lock-bar pipe sections, and straightened flat before pulling.



MORE LOCK-BAR FOR DETROIT.—*This view shows installation of Lock-bar steel pipe 36" in diameter and 3-8" thick along an attractive residence street in Detroit, Michigan. Many miles of Lock-bar pipe have been installed by this great municipality.*

Now Manufacturing "Lock-bar Pipe"

For the first time, Lock-bar Steel Pipe is now manufactured in California. This Company has arranged for the necessary equipment and is prepared to execute orders promptly. -:- -:-

Western Pipe & Steel Co.

of CALIFORNIA

444 MARKET ST.
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FACTORIES

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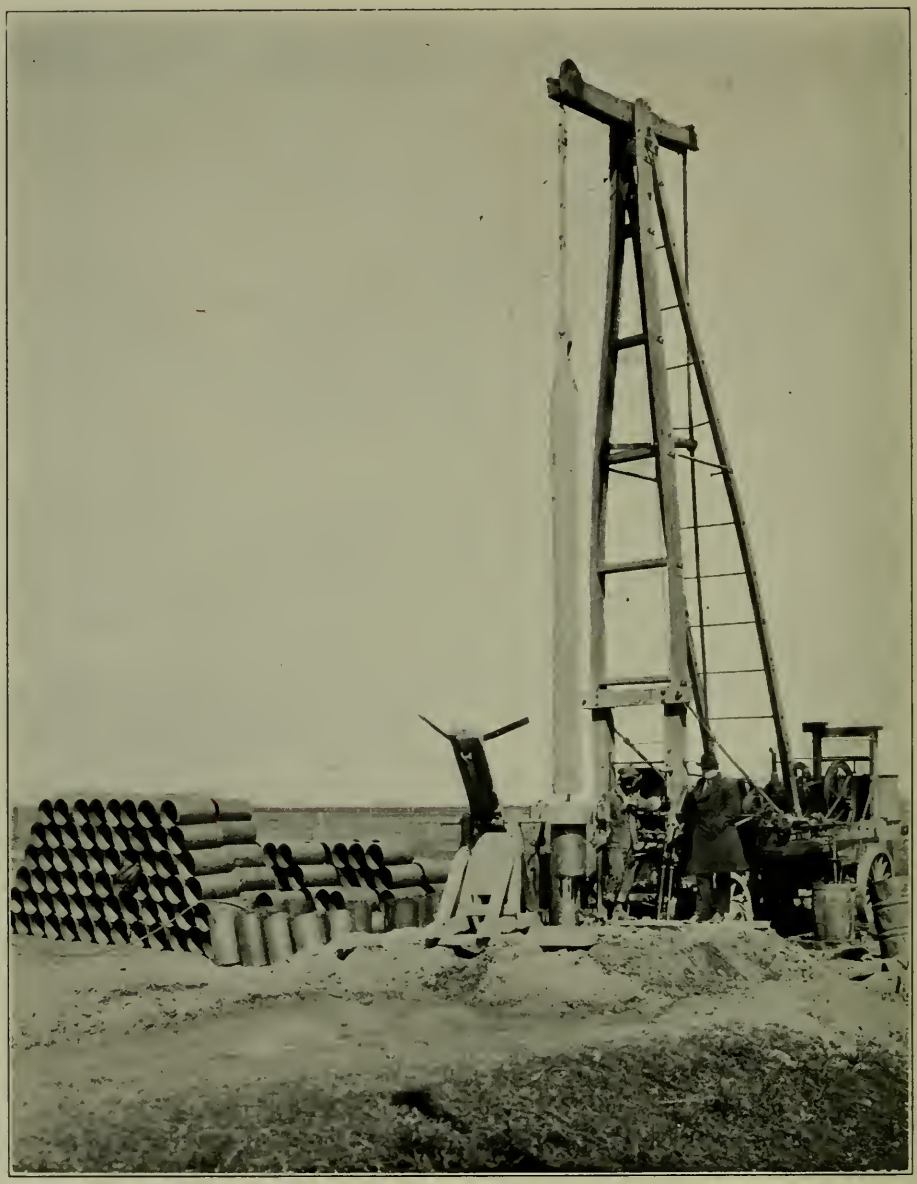
WESTERN PIPE AND STEEL NEWS



W. P. & S. WELL CASING IN THE FIELD.—*D. P. Bramlette, Fresno well contractor, standing beside one of his rigs on a well near Fresno. The casing shown in the picture is the famous "Western" hard red steel. Mr. Bramlette has used this casing in hundreds of wells in the Great Valley.*

THE COVER PICTURE.—*A general view of the Fresno plant of Western Pipe & Steel Co. forms the cover of this issue of Western Pipe & Steel News. Situated at the corner of Broadway and Cherry streets, and covering an area 125'x300', this plant is devoted to supplying the needs of the San Joaquin Valley in water well casing, surface irrigation pipe, tanks, general sheet jobbing work, etc.*

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SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

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Western Pipe & Steel in Fresno, Capital of the Empire of the San Joaquin

IN A STATE where tradition has made phenomenal things ordinary, two developments stand out as extraordinary—Fresno and the empire of which it is the commercial and financial capital, the San Joaquin Valley.

In early days the San Joaquin Valley was one of the great wheat belts of America. Here was laid the action of the story "The Octopus," first volume of the trilogy on the theme of wheat, as conceived by that incomparable reporter-novelist, Frank Norris.

The great bowl of the San Joaquin Valley, inclosed on the east by the snow-clad Sierra Nevada, on the south by the Tehachapi, and on the west by the Coast Range, holds within its enchanted rim a population not far from 400,000. It perhaps boasts the widest range of industries, all based upon and growing out of the natural resources of the region, known to any similar area in the world.

Among these industries are, first, agriculture, including such diversified crops as grapes, figs, peaches, apricots, grain, hay, alfalfa, potatoes, and last but not least, cotton. Lumbering and oil are important industries, and beef cattle upon a thousand hills testify to the fundamental soundness of the region. Northward the storied county of Mariposa recalls pioneer days, with its great deposits of gold-bearing quartz, which have yielded millions, and in this era of cheap electrical energy may yield even more. The business of dairying is by no means unimportant in the San Joaquin. Cotton raising is in its infancy, but already the Valley promises to outdistance some of the southern states in both quantity and quality.

Fresno, the metropolis of the San Joaquin, is a comparatively new star in the firmament of the commonwealth called California. Founded in 1885, the metropolis-to-be, like many another California settlement, kept its early Spanish name. Fresno, in the language of the Dons, means "White Ash Tree," which is abundant thereabouts.

Eleven years before its incorporation as a village, that is to say, in 1874, the population of the settlement was less than eight score. A mere whistling post on the railroad, it boasted fifty-five buildings, commercial, residential, and non-descript.

Today the population of Fresno is probably close to 80,000. Within a ten-mile radius live 30,000 people whose status is semiurban, by virtue of the automobile and the paved highways that lace this wonderful valley like the lines of a cross-word puzzle.

The story of the transition of the great valley from endless leagues of wheat fields to diversified farming is a story written in water and illuminated by man-controlled lightning, representative of his greatest victory over the elemental forces of nature.

Water and electricity! These are the magic keys with which man has unlocked the door to the development of the Garden of the Sun.

Western Pipe & Steel has had an important role in helping to forward the growth of the San Joaquin Valley. The company established an office and warehouse in Fresno in 1912. The original shop was only 50 feet by 80 feet. Today the plant, situated at Broadway and Cherry streets, covers an area 125 feet by 300 feet, and the main shop building is 100 feet by 200 feet. From fifty to seventy-five men are constantly employed here, engaged in the fabrication of such products as water well casing, galvanized tanks, wagon tanks, smoke stacks, black welded tanks, and general sheet jobbing work.

The Fresno plant of Western Pipe & Steel has been enlarged five times since its establishment in 1919 and it is now five times its original size. Thus does the company strive to keep abreast of the development of the regions in which it operates. Improvements and additions costing in excess of $20,000 were only recently completed. Plans are under way at the present time for the installation of automatic electric-welding equipment for the fabrication of light steel pipe for the transmission of water, gas, oil and air.

The territorial range covered by the Fresno plant is from Bakersfield on the south to Stockton on the north. Three salesmen are engaged constantly in covering this region, keeping in contact with customers and prospects, and studying the needs and the problems of the great valley. The company operates its own fleet of motor trucks, delivering its products direct to customers, where this type of transportation is most logical. For rail shipments the facilities are perfect. A spur track of the Southern Pacific runs through the plant for its entire length. Cars destined to points on the Santa Fe are switched through the Southern Pacific interchange.

A birdseye view of a portion of the business section of Fresno. This gives an idea of the phenomenal growth of the metropolis of the Garden of the Sun in the last few years.

In line with its policy at all plants, Western Pipe & Steel Company carries at all times a heavy stock of steel sheets and plates in order to assure prompt delivery on all orders. At Fresno, where a great deal of water-well casing is made, there is always on hand a heavy stock of hard red steel. For general galvanized jobbing work and for such products as wagon tanks, discharge pipes, etc., there is always an adequate supply of galvanized sheets. For the fabrication of smoke stacks and similar work, blue annealed sheets are carried, while black steel is amply provided to meet the demand for such products as welded tanks.

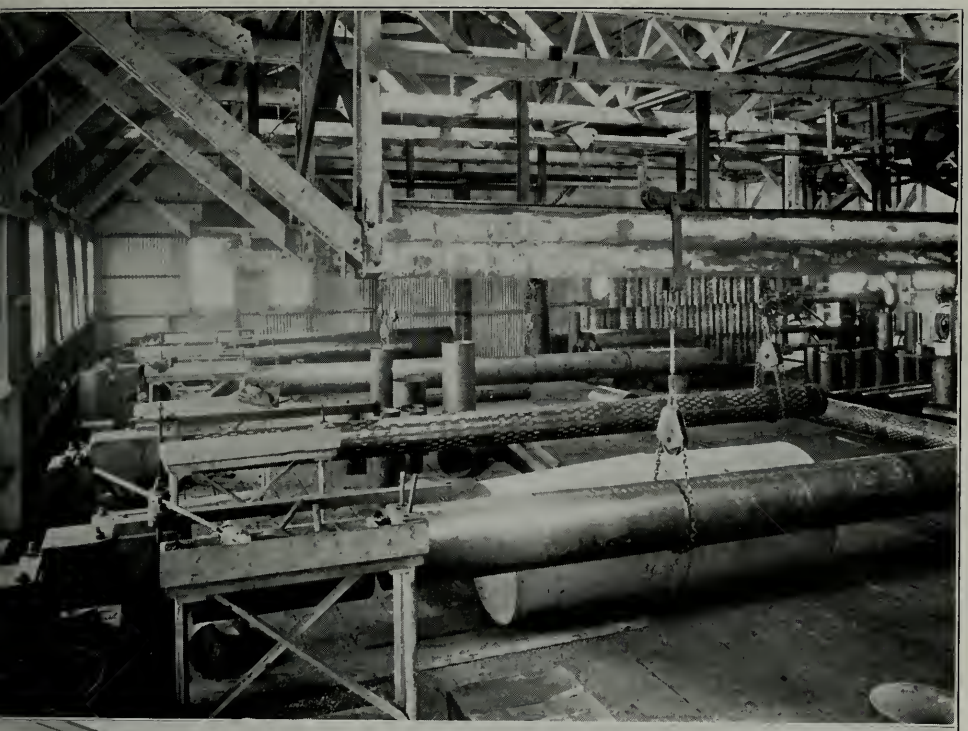
Besides carrying a heavy stock of materials, it is the policy of the company, as well, to have always made up and available for immediate delivery, large quantities of water-well casing from 5-inch No. 16-gauge collar casing to 14-inch No. 12-gauge double casing. Steel well rings are also heavily stocked, ranging from 5 inches by 3 inches by 3-8 inch up to 24 inches by 12 inches by 1 inch.

Another product stocked for spot delivery is portable galvanized surface irrigation pipe. This pipe is made up in sections 10 feet long, diameter ranging from 6 inches to 10 inches. This portable irrigation pipe is widely used in the San Joaquin Valley. It eliminates the loss of water by evaporation and from seepage, and will pay for itself over and over again. The loss of water through these causes invariably accompanies ditch distribution and the most practical and economical way to avoid such loss is through the use of portable surface pipe. This product is also used extensively for the surface distribution of water in connection with underground irrigation systems.

In connection with the manufacture of well casing, it should be reiterated here that Western Pipe & Steel Company uses only the best quality of hard red steel, which experience has proved to be the best material for the purpose. Before leaving the shops every joint is lathe-trimmed and fitted to insure perfect fit and alignment in the field.

A glimpse of the office of Western Pipe & Steel Co. at Fresno. Here orders are booked and deliveries arranged for the vast stretch of territory from Bakersfield to Stockton.

VIEWS OF THE FRESNO PLANT OF WESTERN PIPE & STEEL CO.—Upper *shows the straight seaming department.* Upper Right.—*A corner of the round seaming de machines and a portion of the sheet stock. The machines include shears, punches, rolls an 450 gallons. These were made for the Lindsay Orchard Heaters Association to carry fue*



facturing water well casing is one of the principal activities of the Fresno plant. This scene ving stove-pipe and slotted casing. LOWER LEFT.—*General view of the main shop, showing* LOWER RIGHT.—*A group of wagon tanks ready for shipment. They are 3' 2" x 8', capacity ge pots.*

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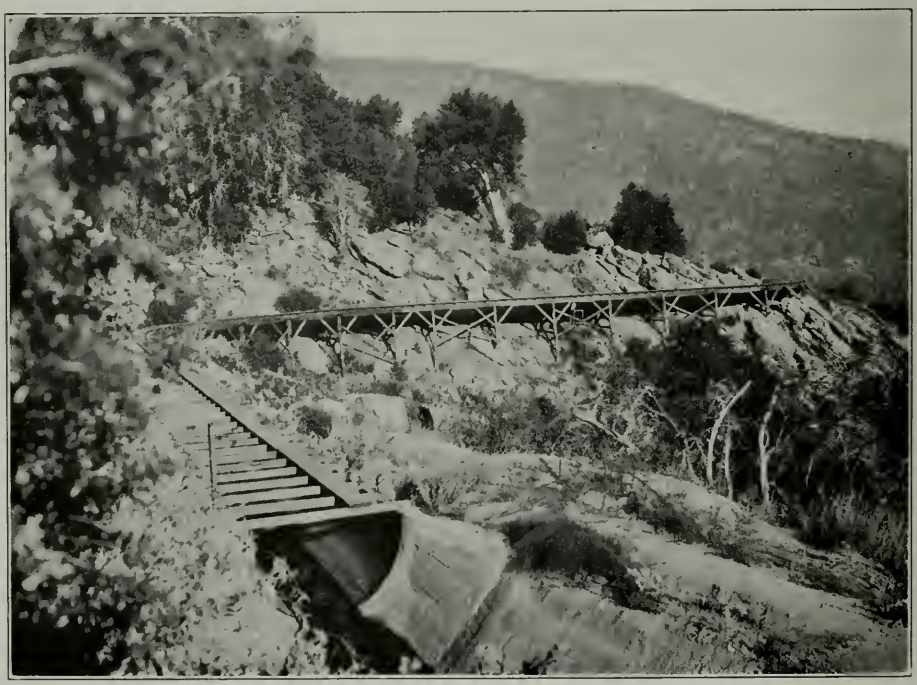
THAT Fresno ranks fourth in this State as an industrial center, being surpassed in the value of its manufactured products only by San Francisco, Los Angeles and Oakland, will surprise many Californians.

The facts are, however, that Fresno now has 140 manufacturing establishments and a hundred wholesale houses. The average annual output of manufactured products is estimated to exceed $80,000,000. Industrial payrolls show approximately 6000 employes with a yearly total of $10,000,000. This is all the more remarkable because all this industrial activity is in the heart of an agricultural region.

The following comment is from the San Joaquin Power Magazine:

Until about ten years ago, Fresno gave little attention or thought to the development of industrial plants and wholesale houses. As an industrial city it has shown most remarkable growth, and today ranks fourth in value of products in California. During this short period of development, manufacturing, in lines other than food products, has taken advantage of the wonderful population gains, railroad service, paved highways, and supply of raw materials near at hand.

Thus it will be seen that the metropolis of the fertile Garden of the Sun has in a very short space of time, taken its place as the manufacturing giant of a rich valley having 400,000 population, 7,500,0000 acres of tillable land, and 3,500,000 acres of highly improved farms. As agricultural development in the San Joaquin Valley is still in its infancy, it is obvious that manufacturing, too, has a bright future.



One of several steel flumes made for San Joaquin Light & Power Corp. at the Fresno plant of Western Pipe & Steel Co. The installation is in the mountains east of Fresno.

Double-dipped, double-riveted water pipe is here adapted for use as an air pipe in heavy tunnel work by the San Joaquin Light & Power Corp on its Kings River project. The pipe is 16" diameter and of 16 gauge steel.

Manufacturing For Manufacturers

THE illustration on the opposite page is presented as an example of specialty work performed by Western Pipe & Steel Co., as manufacturer for other manufacturers. The Pacific Electric Manufacturing Co. turns out these oil circuit breakers in large quantities for the entire United States and for export as well. Western Pipe & Steel supplies them with the tanks.

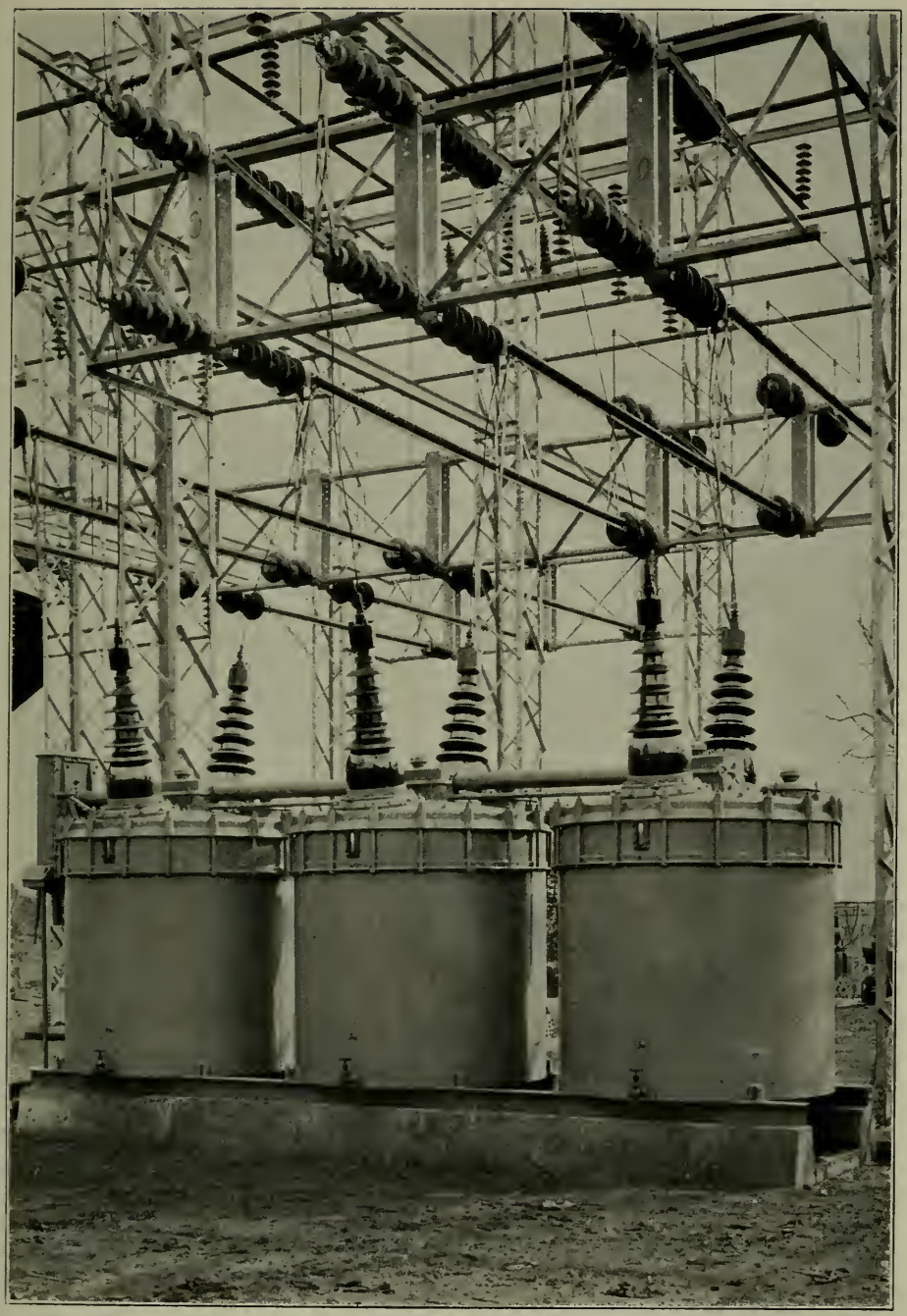
Power company engineers of the Pacific Coast will be interested to know that this particular oil circuit breaker, manufactured in San Francisco, was shipped to the Atlantic seaboard and installed at Spartanburg, South Carolina. It is one of several which the Pacific Electric Manufacturing Co. have furnished to the Southern Power Co.

It is designed for use at 132,000 volts, with 400-ampere continuous current carrying capacity and 1,000,000 KVA rupturing capacity.

The circuit breaker is electrically operated by remote control from within the adjoining substation. The tanks shown are 72½ inches in diameter and 60 inches high. The shell is made of quarter-inch plate and the bottom plate is three-eighths-inch thick.

Another size tank for oil circuit breakers of which a great many are turned out, is 45½ inches in diameter, 42 inches high, with shell five-sixteenths-inch thick and bottom seven-sixteenths-inch.

A Bramlette Drilling Co. rig on a well for the Fresno Irrigation District, Pine Flat Project. Western Pipe & Steel hard red steel casing was used here, as on scores of other wells for this project.



AN EXAMPLE OF W. P. & S. SPECIALTY WORK.—*Oil Circuit Breaker manufactured by the Pacific Electric Manufacturing Co. of San Francisco. Tanks made by Western Pipe & Steel Co. The picture came from Spartanburg, S. C., where this breaker was installed by the Southern Power Co. Designed for use at 132,000 volts, with 400 ampere continuous current carrying capacity, and 1,000,000 KVA rupturing capacity.*

WESTERN
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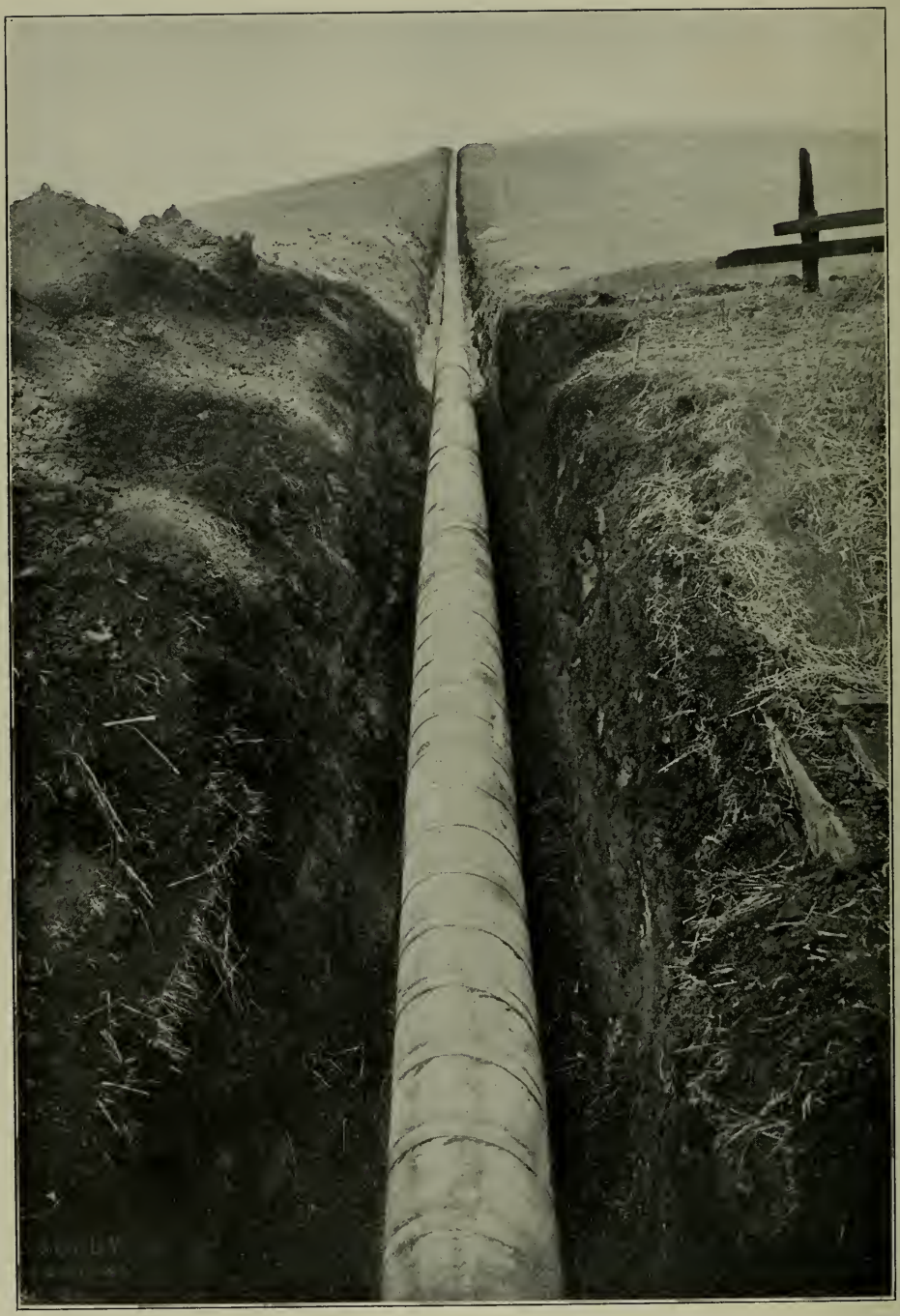
NEWS



ILLUSTRATING THE ADVANTAGES OF STEEL PIPE INSTALLATION ON STEEP HILLSIDES.—*It is hard work to walk up a slope like this, yet the installation of steel pipe—Vallejo's Gordon Valley project— was completed with dispatch.*

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The Gordon Valley Project—A New Water Supply for the City of Vallejo

By A. KEMPKEY, *Consulting Engineer*

BEGINNING on Thursday, March 4th, 1926, the twenty-two mile steel pipe line fabricated and installed by Western Pipe & Steel Co. of California for the Gordon Valley Project of the City of Vallejo, was put under final test for forty-eight consecutive hours, in accordance with contract specifications. For this length of time the pipe was held under a pressure of 200 lbs. per square inch at the lowest point in the line, the test being recorded with Bristol recording gauge.

A. KEMPKEY

The line was found to be absolutely free from leaks. During the forty-eight hour period the line was continuously patrolled and inspected at all points, but no leakage was discovered.

It is worthy of note that this pipe line, designed for the transmission of water from the new Gordon Valley Reservoir to the City's Fleming Hill Reservoir, immediately north of Vallejo, was laid last summer, during the hottest months of the year, and was filled during the winter months. Most of the line traverses terrain of a rugged nature, as will be seen from the illustrations that accompany this article.

During the time of filling the line—and it should be borne in mind that there are some twenty-two miles of light steel plate construction, of which fifteen miles is 24″ diameter, and seven miles 22″ in diameter—only twenty leaks developed in the entire 116,000 feet of pipe. Only one of these occurred in the straight seam, the other nineteen appearing in girth seams. In two instances it was found that girth seams had pulled apart due to contraction when the line was filled with water. These were promptly re-welded and stood all final tests without difficulty.

The fact that only nineteen girth seams showed leakage becomes impressive indeed when it is considered that there are approximately 8,200 girth seams in the entire line. Of these about 4,100 or one-half, were field joints which were hand welded (non-automatic). The remaining 4,100 girth joints were shop welded (semi-automatic).

Following the final tests and inspection, the pipe line was officially accepted by the City of Vallejo on April 2nd, 1926. The following brief outline of the Gordon Valley Project has been prepared for the benefit of those who may be interested in some of the details of the work.

The City of Vallejo is situated in Solano County, California, near the head of San Pablo Bay, on the east shore of Mare Island Strait. It has a population of 26,000.

The water supply is municipally owned and is secured from storage reservoirs in Wild Horse Valley, about 14 miles northeast of the City.

The growth of the City as well as the increasing demand of Mare Island Navy Yard, which is supplied by the municipal system, made necessary a material increase in supply. Engineering studies as to the most economical source and extent of such increase were initiated in June, 1920, and resulted in a bond election in October, 1920, at which time bonds in the amount of $1,250,000 were voted for the construction of the Gordon Valley Project.

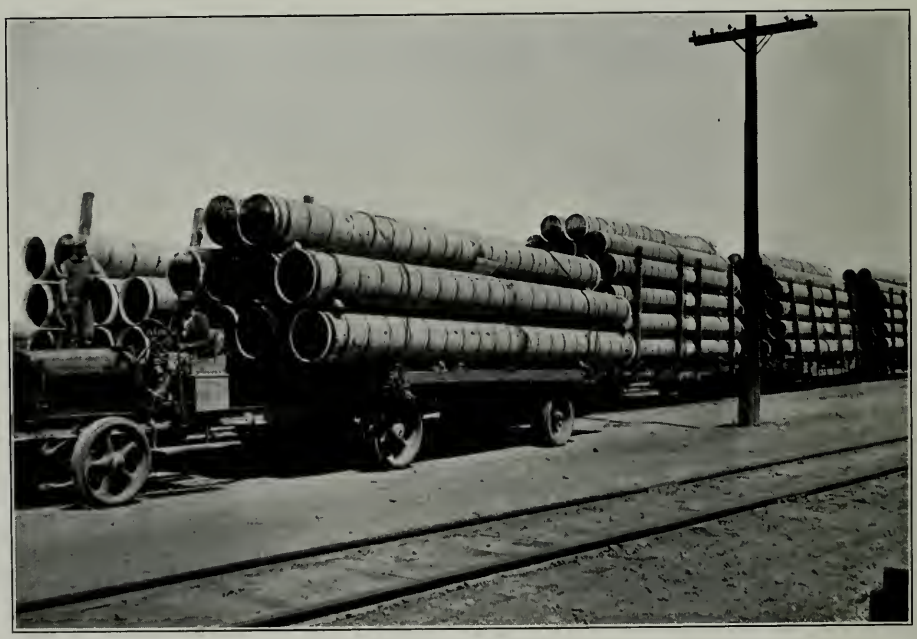
This project involved the creation of a storage reservoir in Gordon Valley at a point about 26 miles northeast of the City, and the installation of a pipeline to connect the same with the existing municipal distributing system.

The City Council authorized the preparation of final plans and specifications covering the dam on July 21, 1924, and a contract for construction was let September 6, 1924.

The Council authorized the preparation of final plans and specifications for the necessary pipe-line to deliver the water into the city distributing system on December 11, 1924, and a contract for its construction was let to the Western Pipe & Steel Co. of California, on March 11, 1925.

Construction has progressed continuously since the award of these contracts until at the present time the project has been completed. The current season's floods have been impounded and a very substantial permanent increase in the municipal water supply assured.

The dam is constructed of earth and



Transporting Pipe From Siding to Field.—Extreme care is exercised in loading and unloading pipe to prevent damage to soil-proof wrapping. Sections are carefully blocked and stripped.

is of the ordinary rolled fill type, containing approximately 300,000 cu. yd. of material, measured in place. The material is a clay shale, of excellent quality for this purpose, easily handled and compacting readily under proper conditions of moisture content. The abundance and character of this material precluded the necessity for a specially selected core, so that the embankment is practically of a uniform character.

The upstream slope of the dam is 2½ on 1 and the downstream slope 2 on 1. The top width is 15 ft. The top is at elevation 392 ft., the elevation of high water is 382 ft. The lowest point in the original bed of the creek was at elevation 296 ft. Stripping operations required the removal of original material to a minimum elevation of 288 ft., making the maximum height of the structure 104 feet.

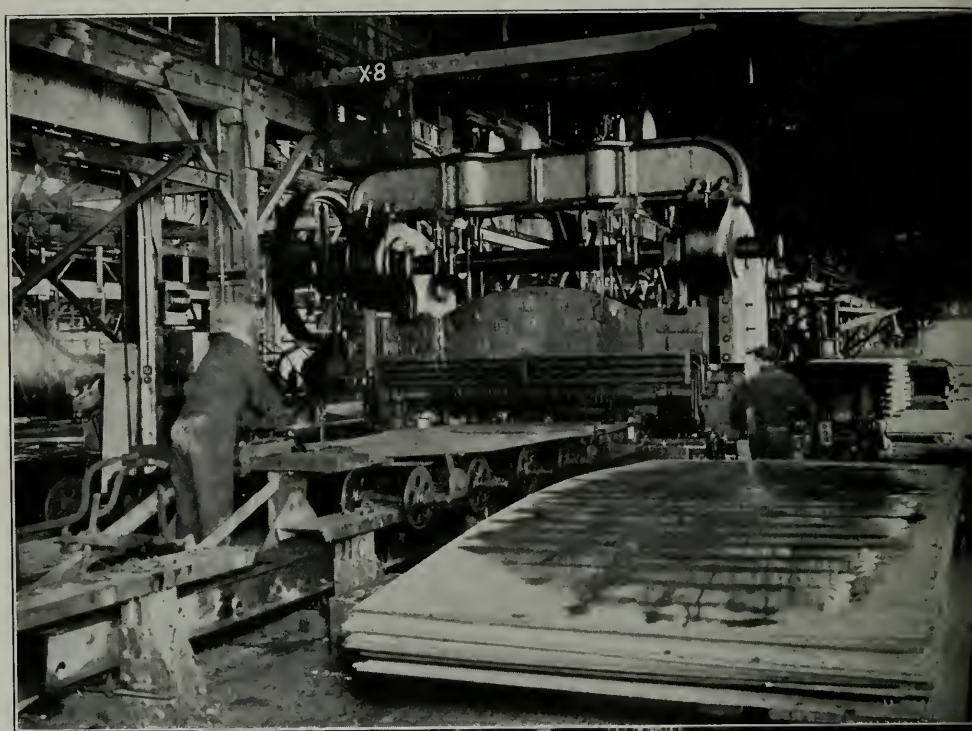
The upstream face of the dam is protected against erosion from wave action by a 6-in. facing of plain hydraulic-concrete laid in 10-ft. squares to provide against unsightly cracks due to possible settlement. These facing blocks were laid alternately and allowed to set before pouring the intermediate blocks. No special type of joint was used between blocks and it is not anticipated that the slab itself will be water tight as a whole.

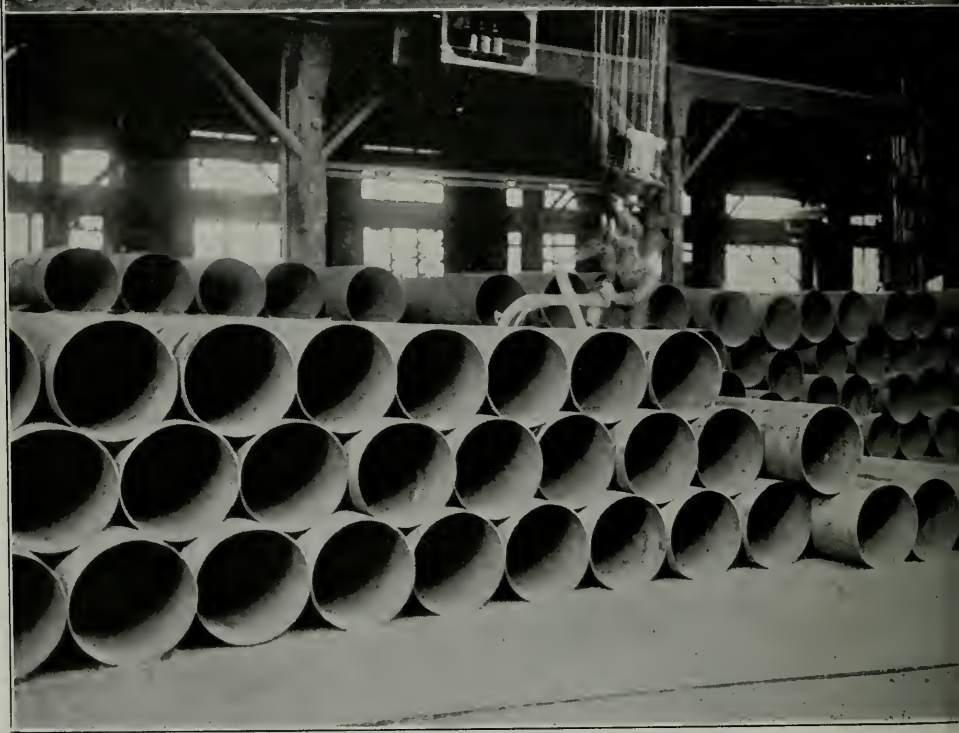
The capacity of the spillway is approximately 5000 second feet with a reduction in the free-board of not to exceed 2 1/3 ft., leaving a net free-board of 7½ ft., and without the use of the extra 5 ft. provided for emergency.

The area of the water-shed being approximately 17 square miles, it is obvious under California Coast Range conditions especially, that there is a large factor of safety as regards available spillway capacity. It was secured, however, at no additional cost, and is certainly not an objectional feature.

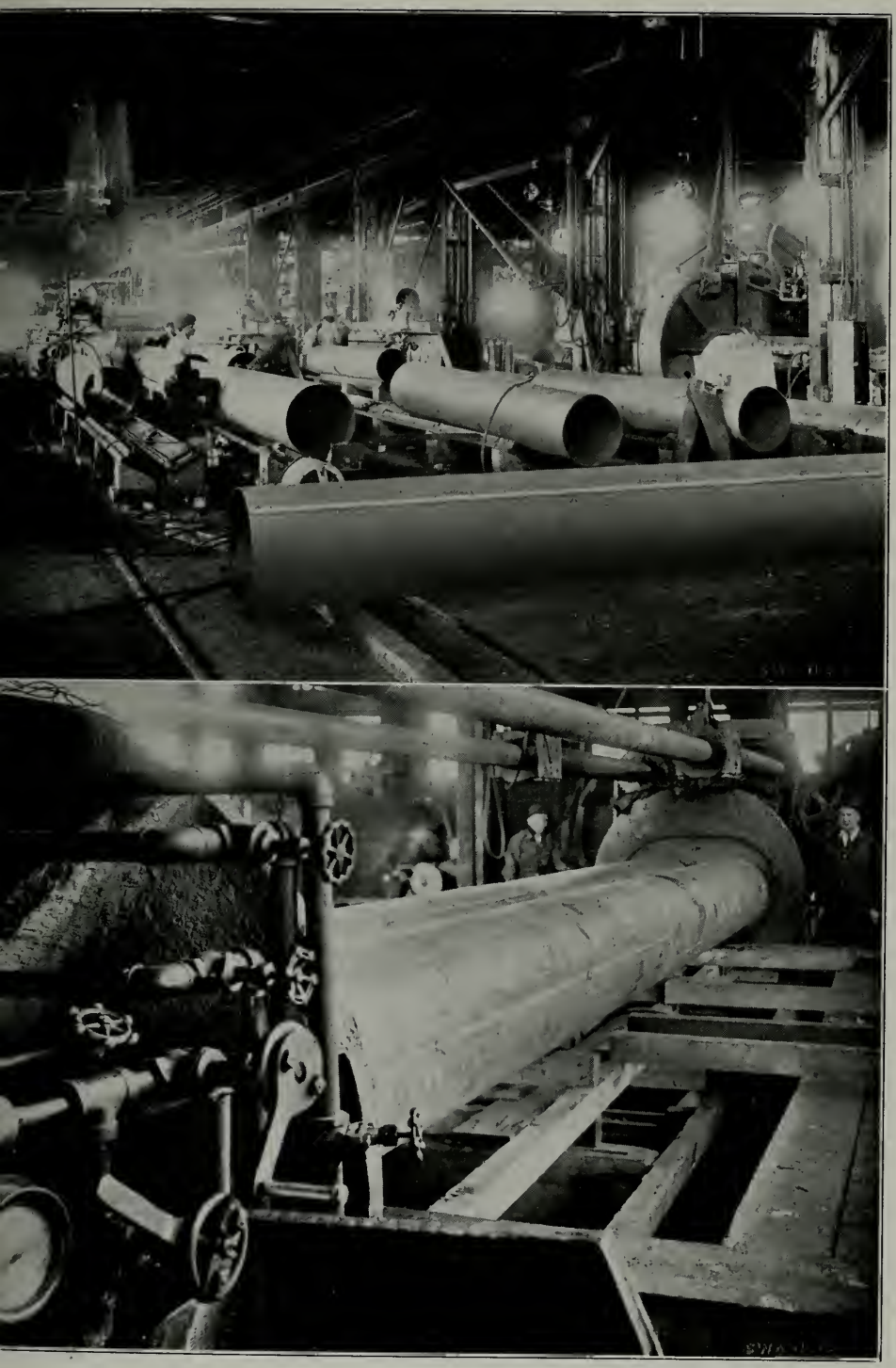
(Continued on Page 7)

Pipe Distributed Along Trench Ready for Installation.—The perfect circles are evidence of proper handling from plant to field. The soil-proof wrapping is also in perfect condition, free from chafing or tears.





THESE SHOP VIEWS SHOW VARIOUS STAGES OF WORK DURING FA
VALLEJO.—Upper Left.—*The first step in fabrication, steel plates being sheared.*
welded. Lower Left.—*The next step in the route through the shop is the testing mac*
two sections of pipe undergoing hydraulic pressure test simultaneously. Every sectio
times the designed working pressure before leaving the shop. From the testing mac
soil-proof covering and is ready for shipment.



OF 22 MILES OF AUTOMATIC ELECTRIC-WELDED STEEL PIPE FOR
—*The plates have been rolled into circular form and straight seams automatically*
hich these completed sections are moving. LOWER RIGHT.—*This unusual scene shows*
cated by Western Pipe & Steel Co. must pass a pressure test of one and one-half
to the dip shed to receive a coating of hot asphalt compound. It is then wrapped with

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444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

ATTENTION is directed to the leading article in this issue of *Western Pipe & Steel News,* which was specially written for our readers by Mr. A. Kempkey, M. Am. Soc. C. E., Consulting Engineer. It embodies a review of the final tests and acceptance of the Gordon Valley Water Supply Project of the City of Vallejo, Calif., as well as a brief general description of the project.

So far as we know, the pipe line supplied by this company for the transmission of water from the Gordon Valley Reservoir to Fleming Hill Reservoir, which is situated just north of Vallejo, is the longest pipe line of its type yet installed in this country.

It consists of twenty-two miles of 22" and 24" diameter electric-welded steel pipe. There are about fifteen miles of pipe 24" in diameter, of which approximately eleven miles were fabricated from steel plate 3/16" thick, the remaining four miles being of 1/4" steel plate. The 22" pipe was made from plates 3/16" thick.

Time and again during the installation of the line, the advantages of steel pipe of comparatively light weight were demonstrated. The country traversed is quite properly described as "hilly terrain."

In many places the grade was quite steep, in fact so much so, that walking up hill along the line of the trench was no easy task. However, the line was installed with efficiency and dispatch.

The design and construction of the entire Gordon Valley Project was carried out under Mr. L. M. Canady, who was in immediate charge as Project Engineer for the City of Vallejo.

In the operation pictured here, the field crew is engaged in lowering into the trench a 100' section on which the field joints have been welded above ground. By this method the number of bell-holes is reduced to a minimum.

(Continued from Page 3)

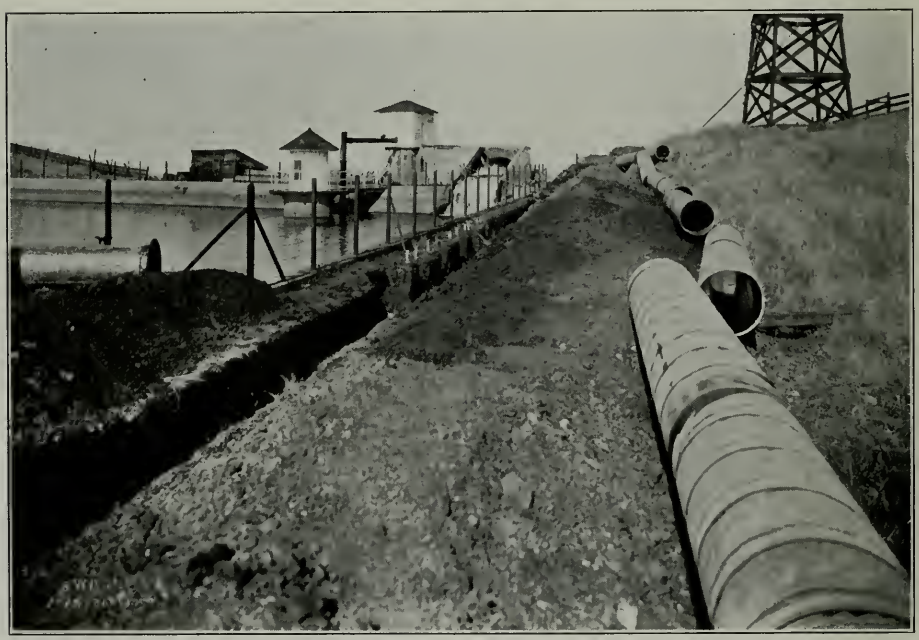
The Gordon Valley reservoir has a maximum flooded area of 300 acres and a storage capacity of 10,000 acre feet. This storage is sufficient to permit a total annual draft of 5000 acre feet to be maintained during cycles of critical years.

The pipe-line extends from the dam to the city's distributing reservoir located on Fleming Hill, a total distance of approximately 22 miles.

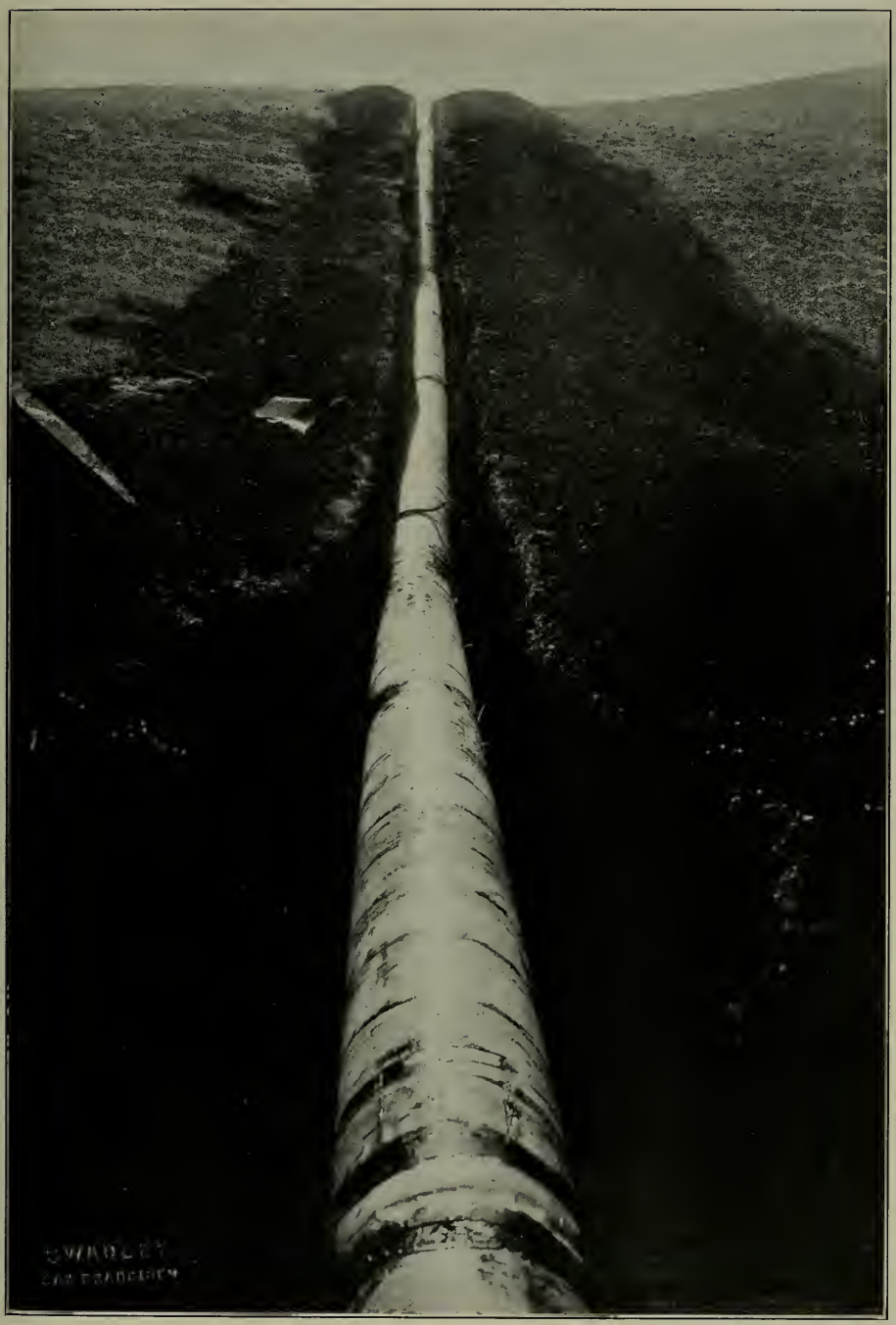
It is of thin steel-plate construction, all seams being electric-arc welded. The first 15 miles has an internal diameter of 24″ and the last seven miles an internal diameter of 22″. Of the 24″ diameter pipe, there are approximately 11 miles, having a wall thickness of 3/16″, and four miles having a wall thickness of ¼″, whereas all of the 22″ diameter pipe has a wall thickness of 3/16″. The total head on this pipe varies from 100 ft. to 400 ft. static.

The pipe is all soil-proofed by being dipped in hot asphalt, and then wrapped, while hot, with a mica pipe-covering consisting of felt which first was thoroughly saturated with a high melting point bituminous compound containing not less than 25 per cent by weight of alkali-resisting mineral and weighing not less than 3.6 lb. per square yard. This felt was put under a tension of not less than 50 lb. per 18 in. of width of wrapping, hot 'dip' being run in between the pipe and the felt during the wrapping process.

Experienced field crews working with modern equipment are always found on Western Pipe & Steel contracts. Picture shows 10-ton caterpillar crane with 35′ boom handling pipe on Vallejo project.



Two interesting views taken during installation of Vallejo pipe line. Upper picture shows pipe along highway ready to be lowered into trench. Below, the original Fleming Hill Reservoir. At right, pipe ready for installation in trench leading into the larger reservoir. On the opposite page, the heavy shadows give the pipe a distorted appearance, but the line is as straight as a taut string.



OVER THE LAST HILL AND UP TO THE RESERVOIR.—*One of the steepest grades on the Vallejo project was up this hill, on the top of which is located Fleming Hill reservoir. The total length of the pipe line from Gordon Valley to this reservoir is twenty-two miles.*

Specialists in the Fabrication and Installation of Steel Pipe Lines

Lock-bar · Riveted · Welded

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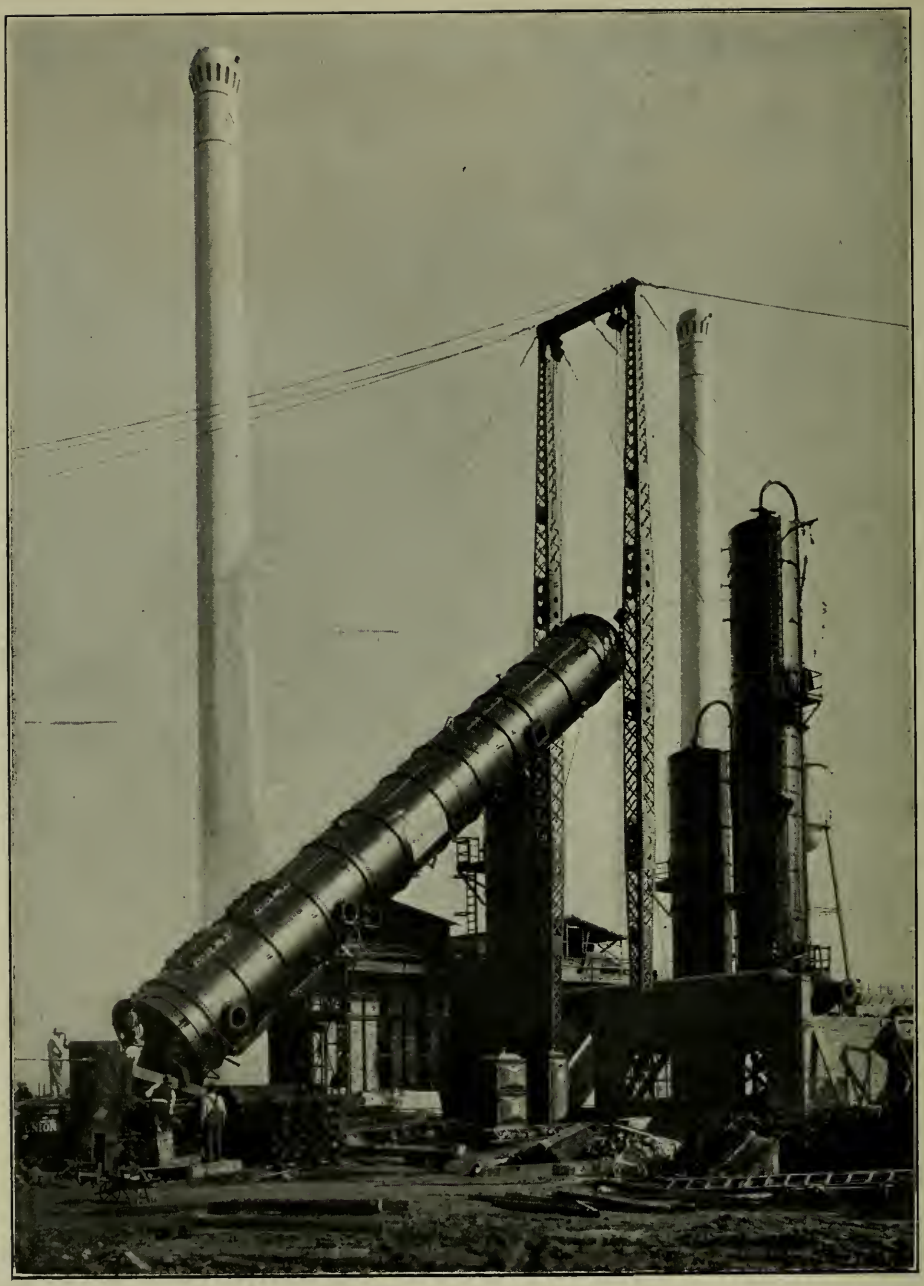
FACTORIES

SOUTH SAN FRANCISCO · LOS ANGELES · FRESNO · TAFT · PHOENIX

Designers · Fabricators · Erectors of General Plate Work

WESTERN PIPE AND STEEL NEWS



OIL INDUSTRY EQUIPMENT IS A W. P. & S. SPECIALTY.—*View shows placing of Kellogg Dephlegmator Tower at Richfield Oil Co.'s Rioco Refinery, near Los Angeles. This tower, whose twin is at the right, is 75 ft. high, 8 ft. 7 in. diameter, weight 124,000 lbs. Picture shows two evaporator towers, 48 ft. 3 in. high by 8 ft. diameter, and, in distance at right, a hemispherical-bottom tank on tower, all fabricated in our Los Angeles plant.*

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME III MAY, 1926 NUMBER 4

Los Angeles Host to Purchasing Agents of Nation, June 9-12

IT IS an event of far more than superficial importance, this gathering of the Purchasing Agents of the nation at Los Angeles for their annual convention from June 9 to 12, for it is bringing to California a group of some 1500 practical and keen business men who collectively represent the greatest buying power in the world today. These men are coming primarily to discuss and seek solutions to the problems peculiar to their profession, but they will also gather and take away with them the facts regarding the growth and development of industry, commerce and manufacture in California.

They will see and enjoy everything that the intelligent tourist sees, but being trained judges of facts and figures, they will carry away perhaps a sounder view of the future of the West, and a better idea of the progress it has made, particularly in the manufacturing field.

Conventions of this type are essentially enlightening and educational in their character, and so when we say that the sessions of the National Association of Purchasing Agents at the Ambassador Hotel will be of lasting benefit to California and the West we have in mind that every delegate will absorb something in the way of new information and impressions that will be as bread cast upon the waters.

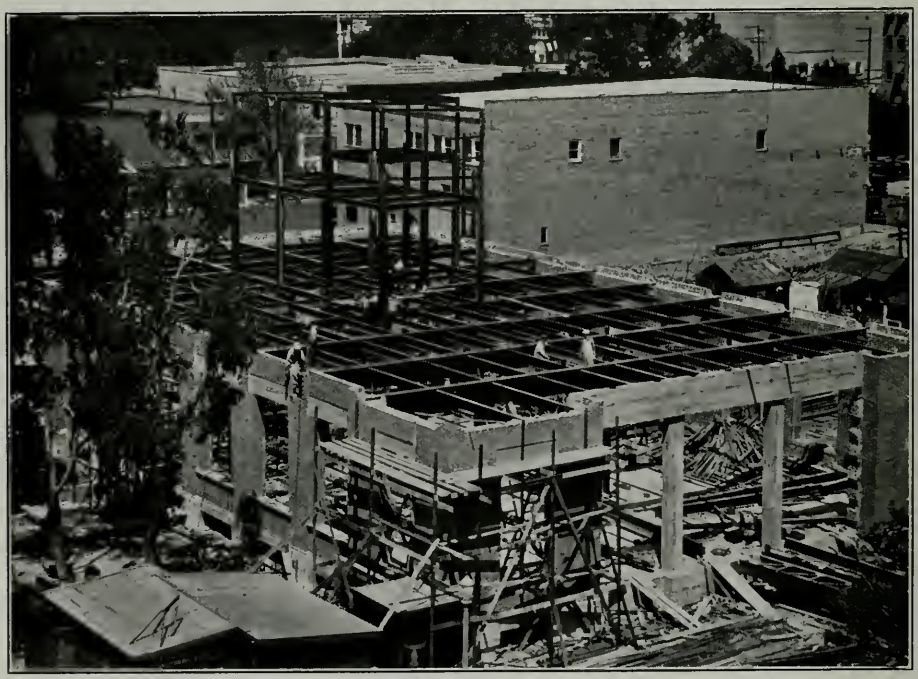
Western Pipe & Steel Co. of California felicitates the City of Los Angeles, and more particularly the Purchasing Agents Association of Los Angeles, for the honor that has fallen to them of playing hosts to this important organization. The personnel of this company joins them in extending a California welcome to the visitors, and pledges co-operation to the limit to make the convention a success.

We are participating as exhibitors in the "Informashow," a feature of these conventions that has come to be a very important adjunct. The products of our five manufacturing plants will be represented in a limited way at Space 78, and we invite all who are interested in work fabricated from steel sheets and plates to visit this exhibit. Our display, which we have striven to make interesting to all who view it, will include models in miniature of tanks, pipe, oil well and water well casing, water heaters, welded products, etc.

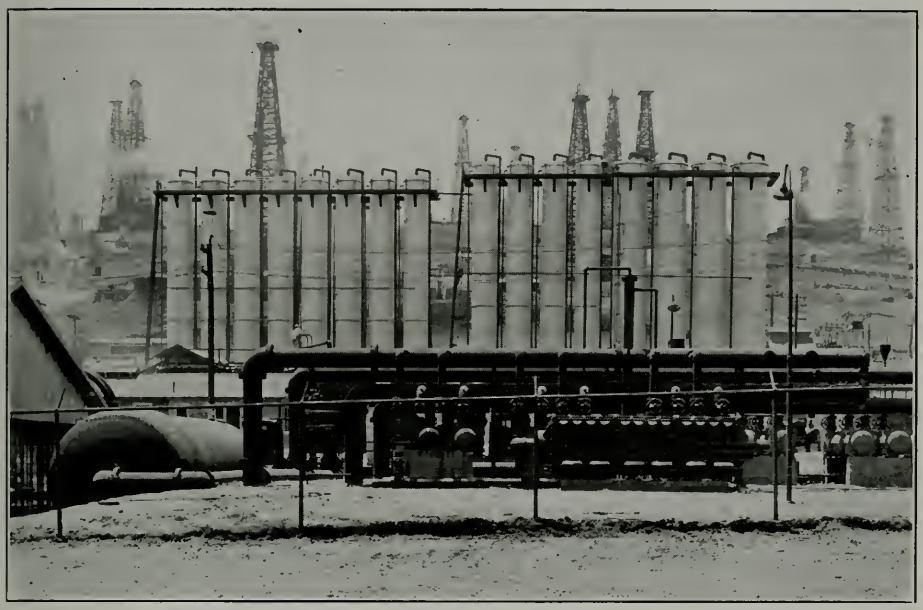
We extend to delegates an invitation to visit our Los Angeles plant. This plant is one of the newest of its kind in the West, and it is one of the largest as well, and we believe the completeness of its equipment and its broad manufacturing range will prove a revelation to most visitors. The plant is at 5717 Santa Fe avenue, near Slauson avenue, and arrangements to visit it may be made at Space 78, at the "Informashow."

Further to illustrate our products and facilities to visiting Purchasing Agents, copies of this magazine will be distributed in conjunction with our exhibit.

Western Pipe & Steel Co. specializes in designing and fabricating truck tanks. Low center of gravity in type illustrated makes for speed with safety. Made for Lang Transportation Co. Combined capacity, 6,300 gallons.

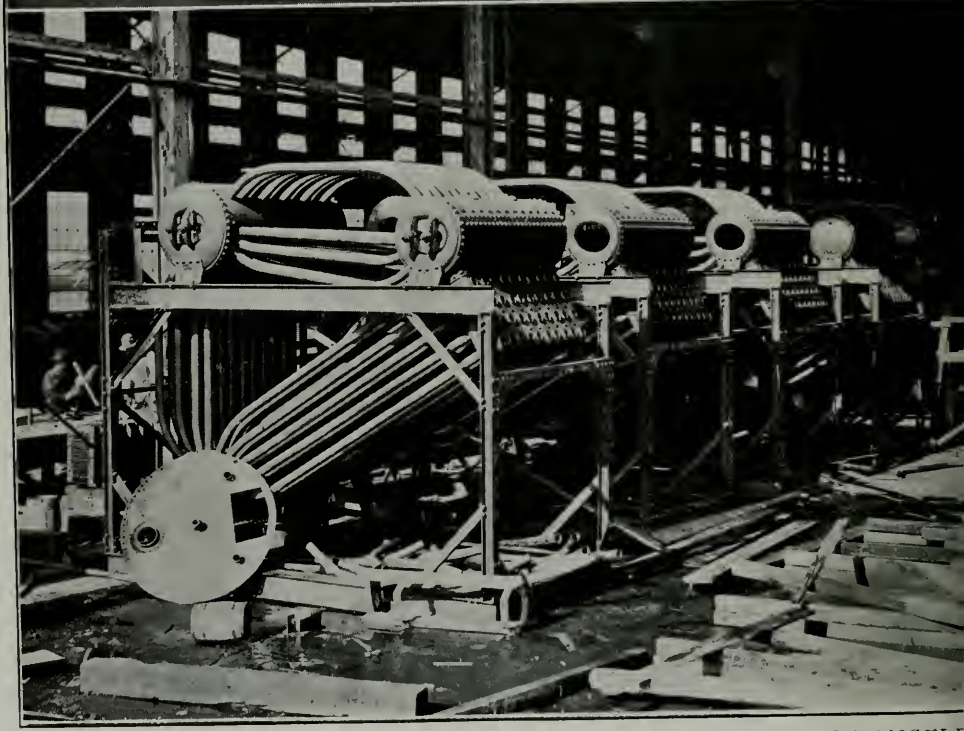


Our structural steel department is equipped for all classes of work of this character. Above building fabricated for the new newspaper plant of the Bakersfield Californian.



Shell Co.'s absorption plant at famous Signal Hill, California. W. P. & S. is equipped to design, fabricate and install every variety of apparatus for the petroleum industry.

This is a portion of the Los Angeles plant of W. P. Fuller & Co. W. P. & S. built and installed all tanks shown, as well as the accessories, including ladders, platforms, gauge-boards, etc.



FOUR SHOP VIEWS TAKEN AT WESTERN PIPE & STEEL CO.'S LOS ANGELE
and some of its products, including cover plates, dished heads, manholes, pressed steel car rolled, while in foreground completed heaters are shown galvanized. At right is machine Southwestern Engineering Corp. This type of work calls for great skill and accuracy. Lo riveted water pipe, steel tanks, dephlegmators, absorption towers, retorts, still bottom plates

O SHOW BROAD MANUFACTURING RANGE.—Upper Left.—*400-ton Hydraulic Press heads, etc.* Upper Right.—*Manufacturing water heaters. In background blank shells are being be connections.* Lower Left.—*A group of Collins type water tube boilers being fabricated for Scene in our heavy plate shop, showing a little bit of everything. In the picture are smokestacks, ads, welded work, etc.*

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EDITED BY EDWARD F. O'DAY

THIS issue of Western Pipe & Steel News has been planned, in connection with the Eleventh Annual Convention of the National Association of Purchasing Agents, to give delegates who may be interested, a fair conception of the work that we are equipped to do, particularly in the field of specialties. This company operates five plants engaged in the fabrication of steel products: Los Angeles, South San Francisco, Fresno and Taft, California, and Phoenix, Arizona.

While we are best known for such products as steel tanks, steel pipe (either riveted, welded or Lock-bar, for the transmission of water, oil or gas) well casing, metal culverts, structural steel and pressed steel products, we design and fabricate an almost unlimited variety of special work, to which the illustrations in this issue are devoted.

Some of the pictures show equipment manufactured for the oil industry, paint manufacturing, etc. We have also had much experience in turning out special equipment for chemical plants, sugar refineries, flour mills, mines, canneries, ice plants, paper mills, packing houses, gas plants, and, in fact, practically every variety of industrial activity. The alphabetical list of products on the inside back cover of this magazine, while necessarily limited, gives a fairly complete index of our products.

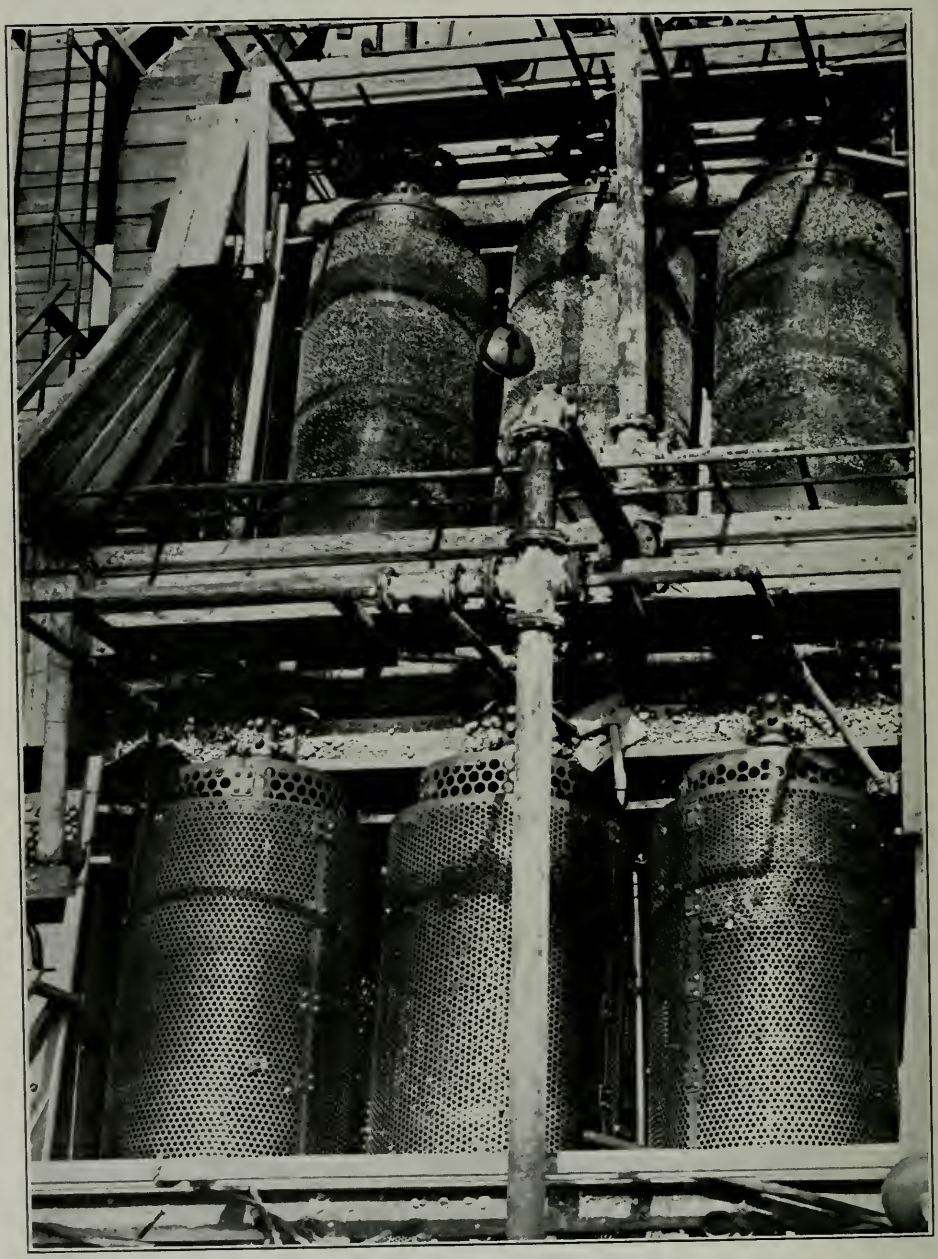
THE COVER PICTURE.—On the cover is a general view of our Los Angeles plant, Santa Fe and Slauson avenues. Frontage, 630 feet, depth, 1215 feet, area, 16½ acres.

The object of this partial view of our huge Los Angeles plant is to give Purchasing Agents an idea of the large stocks of plates, rivets, etc., carried on hand. This insures prompt deliveries.

Here is a corner of the Galvanizing Department at Los Angeles. Its products include ice cans, surface irrigation pipe, drip pans, straight side and corrugated galvanized tanks, etc.

This picture covers about one-quarter of our well casing shop, Los Angeles plant, which is one of the busiest departments we have. Hard red steel is used exclusively for well casing.

"Made in Los Angeles"



A unique illustration of specialty work fabricated at our Los Angeles plant. These are rock screens, made of ¼ in. plate, for Union Rock Co.'s plant at Azusa, Cal. The picture was taken looking almost straight down, the screens operating on horizontal shafts.

SPECIAL COLLECTIONS

PURCHASING AGENTS' REFERENCE LIST OF PRODUCTS

MANUFACTURED BY

Western Pipe & Steel Co.

OF CALIFORNIA

Absorption Plants
Accessories, Oil
Accumulators
Acid Tanks
Agitators
Air Condensers
Air Receivers
Air Pipe

Black Steel Tanks
Boilers
Bolted Tanks
Braces, Pressed Steel Car
Brine Tanks
Buildings, Steel
Burners, Refuse

Car Sills, Pressed Steel
Casing, Oil Well
Casing, Water Well
Condenser Boxes
Cooling Towers
Corrugated Culverts
Corrugated Tanks
Culverts, Metal

Dephlegmators
Dredge Pipe

Evaporators
Filters
Fire Stills
Flumes, Steel
Fuel Oil Storage Tanks

Galvanized Air Pipe
Galvanized Culverts
Galvanized Irrigation Pipe
Galvanized Tanks, Corrugated
Galvanized Tanks, Straight Side
Gas Holders
Gas Traps
Gasoline Storage Tanks
Gasometers
General Plate Work
Gravity Tanks
Grease Kettles

Heat Exchangers
Heaters

Hemispherical Bottom Tanks
Holders, Gas
Hydro-Pneumatic Pressure Tanks

Ice Cans
Irrigation Pipe, Galvanized

Jobbing Work, General Sheet

Kettles, Grease
Kettles, Steam Jacketed

Lock-Bar Steel Pipe

Metal Culverts
Metal Flumes

Oil Accessories
Oil & Gas Separators
Oil Refinery Equipment
Oil Storage Tanks, Steel
Oil Well Casing

Parts, Pressed Steel
Penstocks, Steel
Pipe, Dredge
Pipe, Galvanized Air
Pipe, Galvanized Irrigation
Pipe, Gas Gathering
Pipe, Lock Bar Steel
Pipe, Riveted Steel
Pipe, Slip-Joint
Pipe, Soil Proof
Pipe, Steel
Pipe, Welded
Pressed Steel Work
Pressure Tanks
Purifier Boxes

Receivers, Air
Refinery Equipment
Refuse Burners
Retorts
Riveted Steel Pipe
Riveted Steel Tanks
Rock Screens
Roof Pressure Tanks

Smokestacks
Soil Proof Pipe

Special Fittings
Special Shapes
Special Tanks
Standpipes
Station Tanks
Steam Stills
Steel Buildings
Steel Flumes
Steel Penstocks
Steel Pipe
Steel Plate Construction
Steel Tanks
Stills
Storage Tanks, Steel
Stovepipe Casing
Structural Steel Work

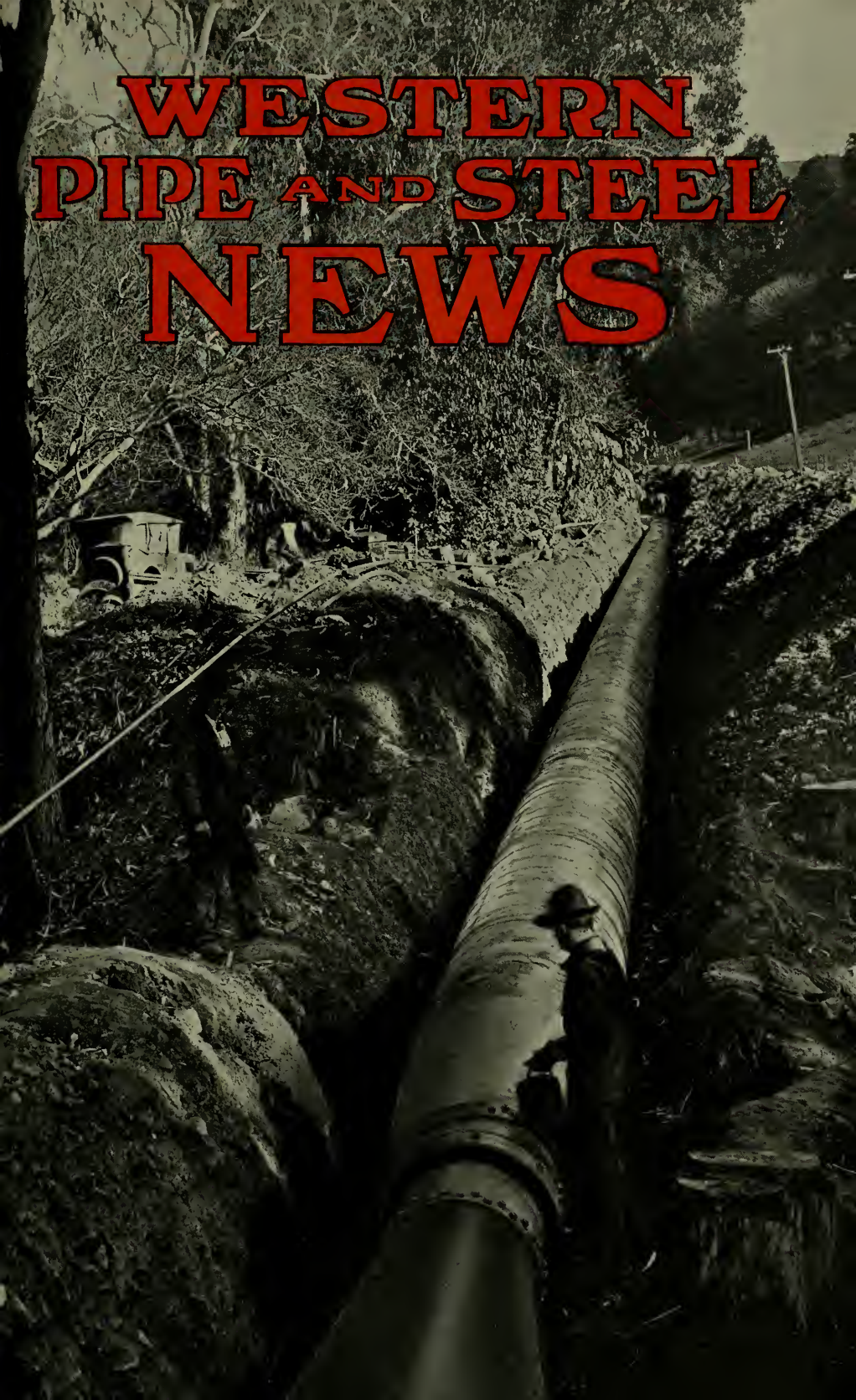
Tanks, Acid
Tanks, Bolted
Tanks, Black Steel
Tanks, Brine
Tanks, Cylindrical
Tanks, Galvanized Corrugated
Tanks, Galvanized Straight Side
Tanks, Gravity
Tanks, Hemispherical Bottom
Tanks, Hydro-Pneumatic Pressure
Tanks, Oil Storage
Tanks, Pressure
Tanks, Riveted
Tanks, Roof
Tanks, Shaped
Tanks, Ship
Tanks, Tower
Tanks, Truck Single or Multiple Compartments
Tanks, Wagon
Tanks, Welded
Towers, Cooling
Towers, Steel Tank
Traps, Gas

Wagon Tanks
Water Pipe Lines
Water Well Casing
Welded Pipe
Welded Tanks
Wrapped Pipe

NATIONAL ASSOCIATION OF PURCHASING AGENTS

ELEVENTH ANNUAL CONVENTION
LOS ANGELES, JUNE 9-12

WESTERN PIPE AND STEEL NEWS



A SPRING VALLEY WATER CO. LINE.—*This view shows a 16" pipe line fabricated by Western Pipe & Steel Co., being installed along Portola Drive, San Francisco. The pipe is wrapped in soil-proof covering.*

Western Pipe and Steel News

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SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME III JUNE, 1926 NUMBER 5

Experience with Riveted Pipe in San Francisco Water-Works

Length of Service, Cost and Advantages Favorable Compared with Cast-Iron Pipe in City Distribution System

By GEORGE W. PRACY

Superintendent City Distribution Department, Spring Valley Water Co., San Francisco, Calif.

[*Special permission for republication extended through the courtesy of the author, and the editor of the Engineering News-Record.*]

IN the early days of California, when hydraulic mining was in full swing, some ingenious miner originated or adopted the idea of riveting plates into cylinders and joining them to form a long line of pipe. In those days all hauling was done by teams and the cost of transporting cast-iron pipe was prohibitive. The late Herman Schussler, who came to California and entered the employ of the Spring Valley Water Co. in 1864, developed the idea until by 1875 he had a considerable mileage of riveted pipe in use. The first of these lines, from Lake Pilarcitos into the city, was finished in 1867. It gave continuous service until 1906, when the earthquake destroyed most of it. The last portion of the line was removed in 1920 after a useful life of 53 years. In fact, its life for other purposes was not yet over, for the portion removed was in such good shape that it was purchased by a second-hand pipe and machinery dealer and resold by him for various uses. Mr. Schussler evidently had some trouble with his first line due to stressing the iron beyond the elastic limit for he had to take up most of it and relay it under a lesser head. Of his second line, the San Andres pipe line, he says in a report made in 1876, "The San Andres line is 30 in. in diameter and 12 miles in length. I subjected the No. 9 iron to 13,100 lb. and the No. 11 iron to 11,400 lb. strain per sq. in., this being from 11 to 20 per cent inside the elasticity limit." This line was laid in 1870 and a great part of it is still in use.

Prior to 1907, all the riveted lines laid, except the submarine pipes, were made of the best grade laminated wrought iron. Since 1907 the lines have been made of steel. The submarine pipes, two 16-in. laid in 1888 and two 22-in. laid in 1901, were made of ⅜-in. steel tubing, first galvanized and then dipped and riveted to cast-iron ball-and-socket joints.

In the development of the city distributing system both riveted sheet metal and cast-iron pipe were used in sizes larger than 16-in. diameter. Pipe 16 in. in diameter and less was all cast-iron. Table I gives the principal data regarding the riveted pipe in use for twenty-five years or more.

TABLE I—RIVETED WROUGHT-IRON PIPE IN SPRING VALLEY WATER CO. DISTRIBUTING SYSTEM

Confined to pipe 25 years or more old

Diameter, In.	Gage of Plates, No.	Thickness of Plates, In.	Length Ft.	Soil	Age in 1925 Years
22	9	5/32	2,105	Hard clay	54
22	9	5/32	12,226	Sand and clay	50
22	7	3/16	10,546	Sand, clay, rock	43
30	3	1/4	3,480	Sand	43
33	3	1/4	2,409	Sand	41
30	3	1/4	4,513	Sand	40
37½	3	1/4	1,818	Sand and clay	40
37½	3	1/4	5,577	Sand and clay	40
37½	3	1/4	1,501	Clay	40
44	3	1/4	4,878	Sandy clay, clay and rock	36
30	3	1/4	4,090	Sand and sandy clay	30
36	7	3/16	420	Sandy clay	25
Total			53,563		

Segregated according to soil: Sand, 27,700 ft.; sandy clay, 11,342; hard clay, 11,388; rock, 3,133 ft.

From an operating viewpoint, these riveted pipes have been entirely satisfactory. During the past sixteen years, I cannot recall having had any trouble with the lines except in two sections within limited districts affected by electrolysis which are noted below. We have several times had to cut small sections from the lines and relay them on account of sewer construction. The sections removed have been about 50 ft. long, the pipe in all cases being in first-class condition. We have also cut into the lines for new connections and have found the iron in perfect shape. Of the two lines with which we have electrolytic trouble, both passed directly in front of a substation. About 3,000 ft. of 37½-in. main thus affected was relaid in 1913, having then been in use 26 years. The 30-in. line was replaced in part in 1919, after being in the ground 49 years. The lines were bonded to the electric return system and have given no further trouble.

The economic side of this type of pipe is interesting. Table II gives a weighted cost of various sizes of riveted steel lines laid in the past few years and also the estimated cost of a cast-iron pipe of the same sizes and same conditions. It must be remem-

Field crew lowering a 200-foot section of riveted steel water pipe with welded field joints, Spring Valley Water Co.

TABLE II—COMPARATIVE FIRST COSTS OF CAST-IRON AND STEEL WATER MAINS AT SAN FRANCISCO

All pipe laid under bituminous pavement.

Size, inches	16	24	30
Cast iron	$6.07	$9.95	$13.70
Riveted steel	4.71	7.28	8.20
Difference	1.36	2.67	5.50
Years for difference in cost compounded annually at per cent to equal first cost of riveted pipe	26	21	9

The 16-in. pipe was made from No. 10 plates, the 24-lb. and 30-in. from plates $\frac{3}{16}$ in. thick. The pipe was double dipped and then wrapped with a special roofing felt. All field joints were welded, shop joints riveted. Class B pipe with cement joints was taken in the estimate for the cast-iron pipe. These lines were laid in built-up but not highly congested districts. In the latter the labor cost would be higher, which would be in favor of the cast-iron pipe. In all cases, detailed estimates would have to be made and the job studied from every angle before a decision could be reached.

bered that these costs are for San Francisco. They may or may not hold true for other parts of the country.

One argument made for cast-iron pipe is that it has a salvage value practically equal to new pipe. With us this is essentially true. Quite recently we took out a 6-in. line that had been in the ground for fifty-two years. After cleaning, it was as good as new and was relaid for another fifty years or more of service. But even this, in large sizes, is not enough to compensate for the lower first cost of riveted pipe as shown by the comparison made in Table II for 30-in. pipe.

Riveted pipe also has a considerable salvage value depending of course upon the length of time it has been in the

(Continued on Page 7)

View along Corbett Road, San Francisco, showing field joint being welded on Spring Valley Water Co.'s 24" line. Pipe fabricated and wrapped by W. P. & S. Co.

TWO IMPORTANT PIPE LINES FABRICATED AND INSTALLED BY WESTER
Spring Valley Water Company. The black pipe in the background is the Alameda count
shows, at the left, the junction between these two pipe lines, 44 inches and 60 inches in dian
Division extends from this point twenty miles west to Crystal Springs reservoir in the hil

TEEL COMPANY OF CALIFORNIA.—*The wrapped pipe is the Niles-Irvington line of ay Crossing Division of the City of San Francisco's Hetch-Hetchy project. The picture y. The location of this junction is a few miles north of Irvington, Cal. The Bay Crossing .*

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5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

IT goes without saying that members of the engineering profession will read with interest the article in this issue of *Western Pipe & Steel News,* written by Mr. George W. Pracy of Spring Valley Water Company, San Francisco. We are printing it, however, not alone for the benefit of engineers, who will be interested in Mr. Pracy's study of the problem of the use of steel pipe in water systems and his conclusions as to the facts, but for the enlightenment of non-engineers, public officials and officers of corporations; county supervisors and purchasing agents; and laymen generally who are or may be concerned with the subject of water supply.

We wish to direct particular attention to the facts regarding the economy and long life of steel pipes as disclosed by the tables compiled by Mr. Pracy to accompany his article. These facts, which will doubtless prove more or less startling to those not familiar with the subject, reflect with scientific — and therefore indisputable accuracy, the experience of Spring Valley Water Company over many years.

Beyond a doubt, the same study of the records of other public utility companies, municipalities, and individuals, would disclose similar results. This state of affairs — that is, that facts ascertained from experience favor steel pipe by a wide margin under conditions such as Mr. Pracy describes — is not new to us. It has, in fact, been the basis of our selling talk for years. Naturally, as large pipe manufacturers, we are gratified to have our contentions receive such unequivocal confirmation from an unprejudiced and disinterested authority.

Another installation of 24" soil-proof riveted steel water pipe for Spring Valley Water Co., San Francisco. Picture shows a long section being lowered into trench.

TABLE III—RELATIVE COST OF LARGE CAST-IRON AND RIVETED STEEL WATER MAINS AFTER 40 YEARS

Assumptions: Diameter, 30 in.; length, 10,000 ft.; pressure, 86 lb.; Class B for cast-iron or $\frac{3}{16}$-in. plates for steel; cast-iron pipe removed, cleaned and sold at original cost price, but steel pipe abandoned after 40 years.

	Cast Iron	Riveted Steel
Original cost	$137,000	$ 82,000
6 per cent interest per year for 40 years	328,800	196,800
Cost of removing and cleaning	43,000	.....
Total expenditures	$508,800	$278,800
Salvage value of cast-iron pipe at original cost of pipe $9.00 per foot	90,000	.....
Net cost	$418,800	$278,800

(Continued from Page 3)

ground and upon the type of soil in which it was laid. A good portion of our pipe has been relaid and some has been relaid twice. We are now relaying some 36-in. pipe which was originally laid in 1888 and removed in 1925. The cost of cleaning and redipping this line was much less than new pipe, the reclaimed pipe being practically equal to new.

The most important element in prolonging the life of a thin metal pipe is the dip, particularly there must be assurance that the pipe is placed in the ditch with the dip intact. Early in its history, the Spring Valley Water Co. developed a dip made by refining a natural asphalt mined near Santa Barbara, Calif. This dip has given very good service. Lately several of our smaller jobs have been dipped in the

Right across the playground in San Francisco's famous Golden Gate Park. This installation of pipe fabricated for Spring Valley by W. P. & S. has just been completed.

ordinary oil asphalt. Lately, also, all pipe has been wrapped with a prepared paper almost identical with roofing felt. This method gives a much thicker coating of asphalt with the additional advantage that the paper prevents the dip from chipping during the handling from the kettles to the ditch.

With a few exceptions, these large, thin metal pipes are not tapped for ordinary house services, but all of them are tapped at street crossings for ties to the distributing system. When the pipe is dry, these connections are made by riveting or welding on outlets as would be done in a boiler shop. If it is necessary to make a tap under pressure, the outlet is fastened to a steel sleeve which is placed around the pipe and the usual lead joint made. The tap is then made with any tapping machine.

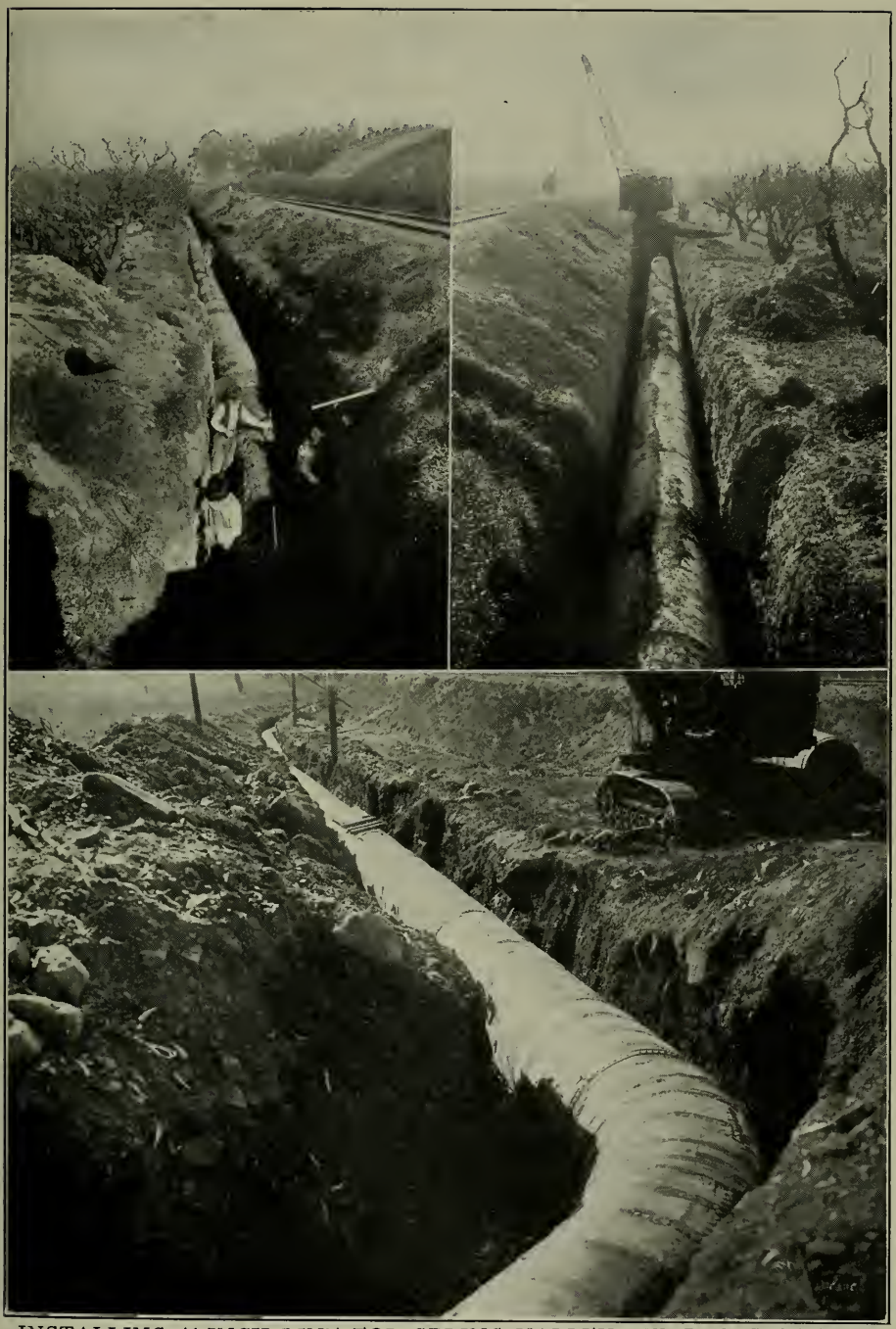
The company has had the same favorable experience with its lines outside of the city as with those within the city. The Crystal Springs line, 44 in. in diameter and 18 miles long, made of No. 6 and No. 7 wrought-iron plates, was laid in 1885 and has given continuous service for forty years and is still in good condition. The Alameda pipe line, 36 in. in diameter and 20 miles long, laid in 1887 and 1888 of No. 7 and No. 9 wrought-iron plates, is in good shape after thirty-eight years of use except for about 2 miles laid through the swamp lands along the bay shore. These two miles will have to be replaced within the next two years. Of the force main from Belmont pumps, 34,000 ft. is 36 in. in diameter of No. 9 iron laid in 1888 and 17,000 ft. is 55 in. in diameter of $\frac{9}{32}$-in. iron laid in 1903. The 54-in. pipe was laid on account of needed increased capacity. One mile of the original 36-in. pipe was replaced this year. It was laid in clay soil along the edge of San Francisco Bay. In the San Andres line, we have 29,000 ft. of 44-in. made of ¼-in. iron plates laid in 1898. The remainder of the San Andres line is about 40,000 ft. of 30-in. pipe of No. 12 iron plates, laid in 1870, except for about 5,000 ft. replaced at various times, principally due to electrolytic trouble. In this section our experience has been that nearly all deterioration is on the outside due to surrounding soil.

After considerable experience in laying thin metal pipe lines from 16 to 44 in. in diameter and maintaining such lines that have been in the ground from one to fifty-four years, it is my opinion that in most cases they should be selected in preference to cast-iron pipe. Either as gravity lines or force mains they give entire satisfaction. Under most conditions they are economical in first cost and in ultimate cost. Care must be taken to see that they are not used under unfavorable conditions and also that they are properly designed and carefully laid.

TABLE IV—VALUE OF "C" FOR RIVETED WROUGHT IRON PIPES OF SPRING VALLEY WATER CO.

Values given for both Williams & Hazen and Chezy formulas

Name of Line	Size, In.	Age of Pipe When Tested, Yr.	Value of C W & H	Value of C Chezy
Alameda, from Niles to Belmont	36	24	107.5	104.8
Belmont to Burlingame	36	24	123.0	122.3
Burlingame to Millbrae	54	9	109.0	106.5
Crystal Springs, Millbrae to Sierra Point	44	27	97.9	96.8
Crystal Springs, Sierra Point to University Mound Reservoir	44	27	89.1	88.5
San Andres, San Andres to Baden	44	14	113.5	109.0
Baden to College Hill Reservoir	30	42	110.0	103.6
Baden-Merced, Baden to Merced	30	5	114.0	107.0
Pilarcitos, Daly Hill to Lake Honda	30	47	91.5	84.0



INSTALLING 44-INCH LINE FOR SPRING VALLEY.—*W. P. & S. fabricated and installed this soil-proof conduit for the Niles-Irvington line.* UPPER LEFT.—*Completing final test.* UPPER RIGHT.—*Backfilling.* BELOW.—*Ready for wrapping field joints. The cover picture of this issue was also taken on the Niles-Irvington line, just below Niles reservoir.*

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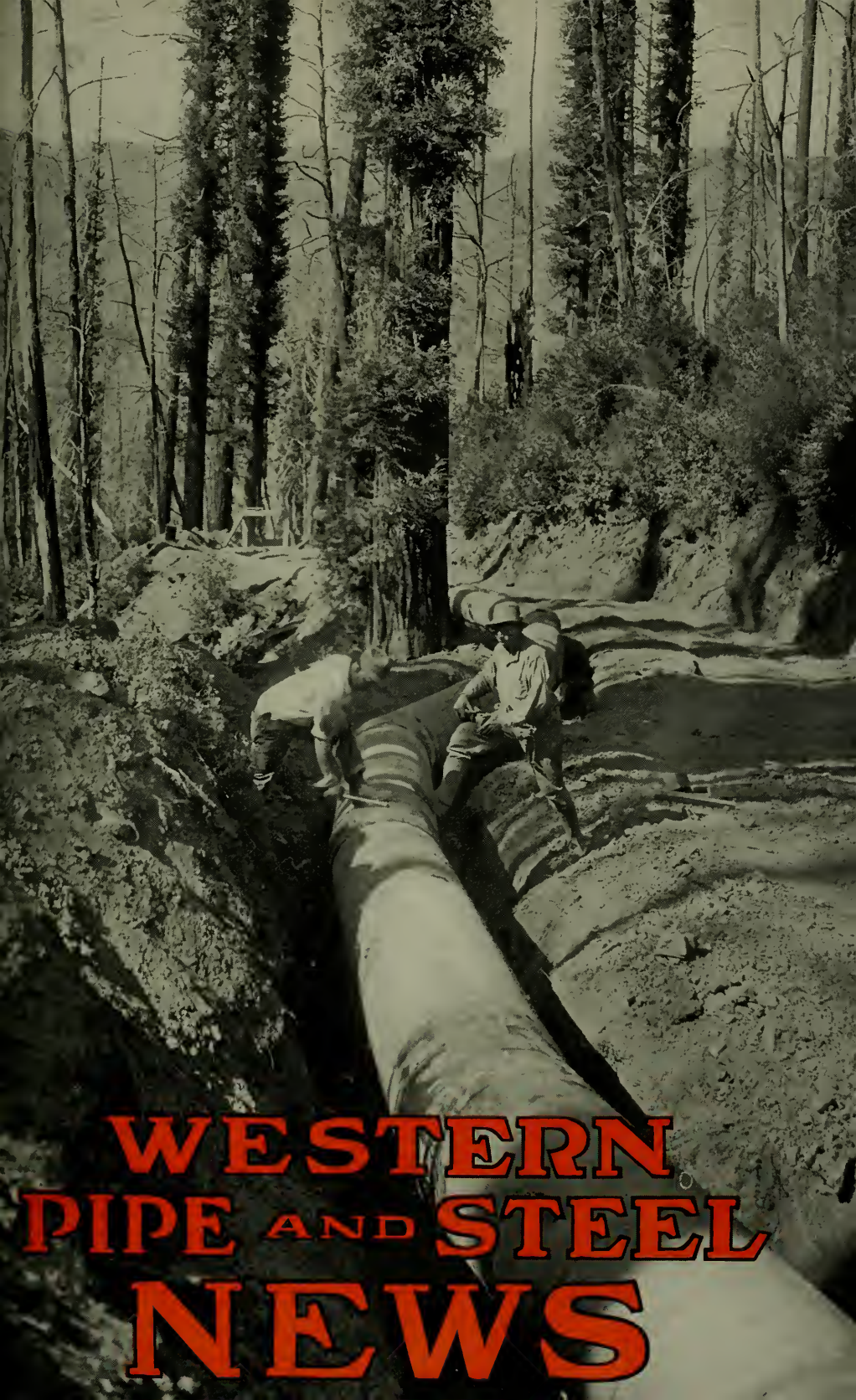

WESTERN PIPE AND STEEL NEWS

INSTALLING NEW STEEL PIPE LINE FOR MARIN MUNICIPAL WATER DISTRICT.—*The angle shown here was made necessary by rock formation, blasting of which was impossible because of the adjacent concrete pine line.*

Western Pipe and Steel News

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SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME III JULY-AUGUST, 1926 NUMBER 6

Marin Municipal Water District Installs New Welded Steel Pipe Line

By J. S. PETERS

Engineer, Marin Municipal Water District.

THE territory served by the Marin Municipal Water District comprises practically the whole of Southern Marin County, with the exception of the westerly slope of Mt. Tamalpais draining toward Bolinas Bay. The principal towns served are San Rafael, San Anselmo, Fairfax, Ross, Kentfield, Larkspur, Corte Madera, Mill Valley, Belvedere and Sausalito. We also supply water to the California-Hawaiian Sugar Refining Co., which barges the water from our pipe line at San Quentin, to Crockett. The present population of the water district is approximately 50,000. We have about 11,000 service connections which give a theoretical population of 47,000, using the customary factor of 4.3. However, San Quentin, which rates as one service, has an average population of over 3,000, so that 50,000 people is probably a very conservative figure.

The Water District owns its entire water shed lands, comprising some 10,450 acres. In addition to this we now have under condemnation some 6,000 acres of water shed lands that can be developed for future needs.

Mt. Tamalpais is, of course, the dominating topographical feature of this water shed. Its three peaks—respectively 2604′, 2550′ and 2586′—the northern slopes of which drain into Lagunitas canyon, supply the major part of our run-off.

Records covering the last 45 years show the average rainfall on this water shed to be 56″ per year. This indicates an ultimate supply of approximately 35 million gallons per day, when the necessary additional storage facilities have been provided. The present storage facilities total 1,882,000,000 gallons. The present daily peak load requirement of the district is approximately 6½ million gallons. These figures, when placed against a possible development of 35 million

(EDITOR'S NOTE—With wise foresight the residents of Southern Marin County, served by the Marin Municipal Water district, last October approved by their votes, a bond issue of $1,500,000 for additions and improvements in their water system. The need for this program is readily appreciated when it is realized that the population of the district has almost doubled in the last decade. In other words, the population in 1916 was about 27,000 and it is now estimated at approximately 50,000. One of the major improvements provided for was the installation of an additional pipe line for the transmission of water from Alpine Dam to Phoenix Gatehouse. This line, the contract for which was awarded to Western Pipe & Steel Co., consists of 30,000′ of 26″, and 7,400′ of 30″ welded steel pipe. The fabrication and installation of this steel pipe offered many unusual problems, not only because of the extremely rugged character of the terrain, as shown by our illustrations, but also because of the difficulties of trenching, not the least of which arose from the fact that the steel pipe line parallels, sometimes within a few inches, the old concrete pipe line, which made rock blasting a delicate operation, to say the least. Until the new steel pipe line is completed and ready to go into service, the water supply is dependent upon the concrete pipe, which was installed in 1916. It was therefore of the utmost importance to conduct blasting without damage to the adjacent concrete pipe. Mr. J. S. Peters, engineer of the Marin Municipal Water District, was more intimately concerned with this undertaking than any one else, and we believe his article will be of unusual interest. M. M. O'Shaughnessy is Consulting Engineer of the District.)

gallons daily, show that there is ample protection against a water shortage for many years.

Before getting away from the subject of rainfall and run-off it may be interesting to point out that the maximum recorded rainfall (winter of 1889-90) was 109.30″. Mt. Tamalpais has several times gauged over 100″. The average rainfall of 56″ gives a run-off of 6 billion to 7 billion gallons on that portion of Lagunitas water shed owned by the Water District.

The Marin Municipal Water District is one community that will not have to worry about the possibility of an increase in population exhausting its local water supply, for a long time to come. It has been conservatively estimated that the acquisition of more water shed lands, the construction of additional storage facilities further down Lagunitas canyon and the raising of the present Alpine dam would develop sufficient water resources to take care of a population of 350,000 people, i. e., 300,000 more than the present population.

The Marin Municipal Water District was formed in August, 1912. The original cost of the project was $3,054,939, of which $1,044,869 was spent on new construction and $2,010,070 was spent on the purchase of the larger existing water companies and acquiring additional water shed lands. The first four years after the District was organized were spent in making the necessary surveys, litigation involving the condemnation proceedings against the existing water systems, and the voting of a $3,000,000 Bond Issue. The existing water companies were taken over by the Water District and actual operating begun on November 1, 1916, and in October, 1916, the first contract under the new construction program was awarded. The contract for the building of the Alpine Dam was let on

Start of the line just below Alpine dam. From this point to Pine Mountain Tunnel there is being installed a pressure line of 18,776 feet of 26″ pipe of 10 million gallons daily capacity.

June 19, 1917, and finally completed on January 7, 1918. The design of the dam is full gravity section, curved in plan, the radius of the upstream face being 465 feet, the crest length 325 feet. Thickness at base is 78 feet. The overflow is taken care of by six "syphon spillways" designed by G. F. Stickney, which have proven entirely satisfactory. In 1923 the dam was raised 8 feet, bringing it to its present height of 108 feet, which increased the storage capacity from one billion gallons to one billion five hundred million gallons. At this time specially designed sluice gates were placed over the mouths of these spillways so that the water level can be maintained at any desired height between the crest of the spillway and the top of the dam.

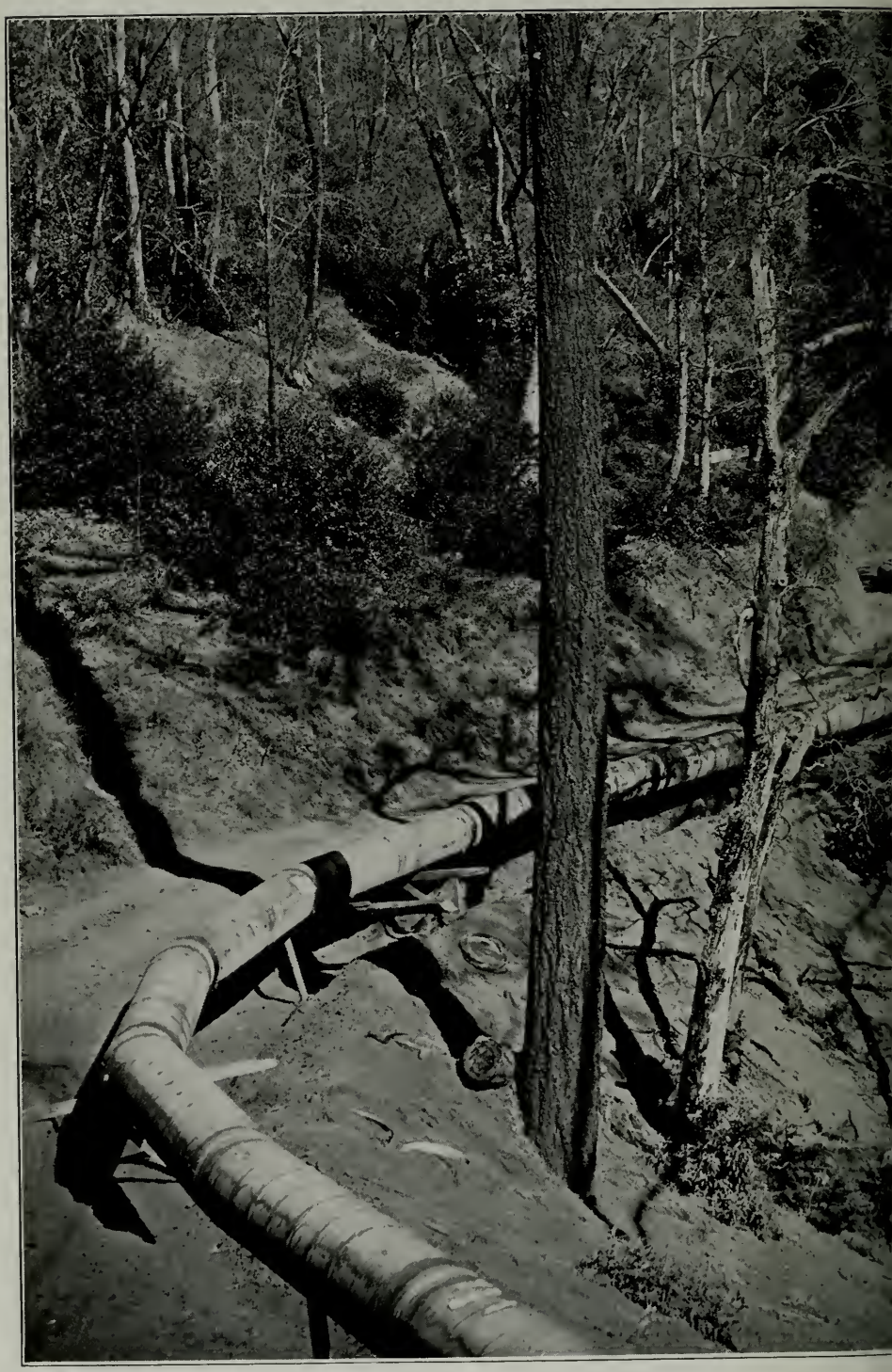
On November 23, 1920, the Water District voted a second bond issue of $500,000 which was spent for improvements to the distributing system, and on October 29, 1925, a third bond issue for $1,500,000 was voted for extensive improvements and enlargements to take care of a steadily increasing demand for water.

The first construction work being done under this last bond issue is the building of an additional transmission line from the Alpine Dam to the Phoenix gatehouse, from which point the water is distributed to the different balancing reservoirs. The contractors for this work are the Western Pipe & Steel Company of California. The pipe line consists of 30,000 feet of 26″ pipe and 7,400 feet of 30″ pipe. All of the pipe is built of ¼″ steel plate.

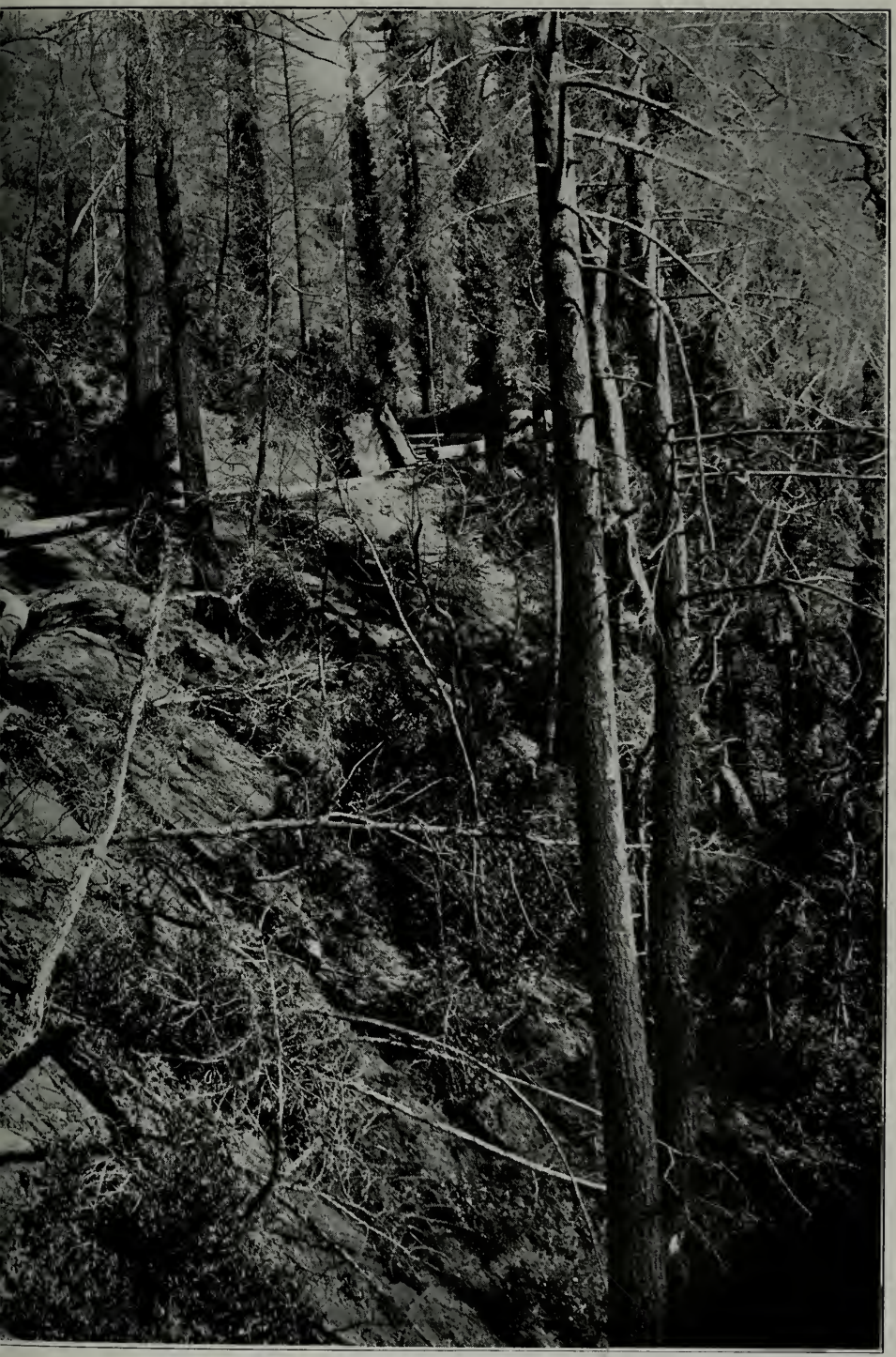
The pipe is preheated before dipping. After dipping the pipe is spirally wrapped with "Western" special felted fabric saturated with bituminous compounds which render it soil-proof. The wrapping is bonded to the pipe by heated asphaltum flowing between the covering and the pipe during the wrapping operation. The covering is applied by machine under a uniform

(Continued on Page 7)

This view illustrates the placing of pipe sections along the edge of the trench. The narrowness of the road made it impossible to yard pipe, consequently practically every section was unloaded at its final place.



THE MARIN MUNICIPAL WATER DISTRICT'S NEW STEEL PIPE LINE CURV
view is typical of the country traversed by the pipe line, which consists of 30,000 feet of 2
Pipe & Steel Co. The line has more curves than the famous Mt. Tamalpais railroad on the
nature of the difficulties of installation. Angles were cut at almost every section of the



Y THROUGH SOME OF THE FINEST SCENERY IN MARVELOUS MARIN.—*This*
o feet of 30 inch soil-proof welded steel pipe, the contract for which was placed with Western
he water shed. Those familiar with this kind of work will understand from this picture the

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WHAT was pronounced by the guests to be the most unique luncheon they had ever attended, was given recently at the Phoenix plant of Western Pipe & Steel Co. by A. A. Burden, manager, to leading professional men and industrial executives of Phoenix, including the Phoenix chapter of the American Association of Engineers.

In connection with the picture below we reproduce the following account from the Arizona Gazette:

The luncheon was held in an originally furnished dining room—the floor and rugs consisted of hard packed earth, the banquet tables were quarter inch sheets of steel, and the room decorations consisted of the machines of the plant.

After the luncheon had been completed and some of the notable guests present had spoken a few words an inspection tour of the plant was conducted by Mr. Burden. He explained the purpose and operation of the many machines and told of the work being carried on by the concern.

Vic Householder, manager of the Phoenix chapter of engineers, conducted the ceremonies.

H. B. Watkins, of the Phoenix chamber of commerce, was the first speaker on the informal program. He, as well as the other speakers, stressed the fact that Phoenix and the Salt River valley are to have increased prosperity this fall and winter.

Robert Phileo, of the First National Bank, said the valley was fundamentally sound and for that reason he believed in the future.

A. T. Estgate, of the Valley Bank, said that the growth of the section should be on a rational and sane basis, without the inflation of a boom period.

This unique luncheon picture was taken at Western Pipe & Steel Phoenix plant when Manager Burden was host to the Phoenix chapter of the American Association of Engineers.

(Continued from Page 3)

tension of 50 pounds per 18 inch width of wrapping. The tension under which the wrapping is applied makes it impossible for loose pockets to occur between the pipe and the covering. The pipe is made and shipped in 14 foot sections, rolled from a single plate. All longitudinal seams are electric welded with full automatic General Electric machine. All round seams are acetylene welded. Weekly tests are made on shop welding; test specimens being cut from sections of pipe selected at random. So far some 30 test pieces have been pulled and only one piece broke in the weld after developing a weld strength of 94%. All other specimens broke in the metal approximately 4 inches away from the weld. A number of bending tests of the electric welded joint have been made and in no case has the weld broken, although the 4 inch test pieces were bent until the ends met, giving a bend of approximately 180 degrees. From these tests it would appear that it is possible to produce in actual shop practice a 100% efficient electrically welded joint using ¼″ plate. Tests were made of an acetylene welded butt joint such as it was intended to use on the round seams. These test specimens showed strengths varying from 94% to 100%. However, we are actually using V joints in the field welding which we believe will insure a 100% weld at every joint. Test pieces were also made to determine the relative strengths of the different welding rods used and apparently the imported Swedish rod gave the best results.

Delivery of pipe began about June 2nd, and to date some 28,000 feet of pipe has been delivered to the trench. The actual installation of the pipe line was begun on June 10, 1926. To date some 20,000 feet of pipe has been welded in place. The installation of this pipe line presented many difficul-

Beautiful scenery did not lessen the difficulties of installing the Marin Municipal Water District's new steel pipe line. This is one of hundreds of curves passing around deep ravines.

ties due to the crookedness of the line and the contour of the country.

Any one familiar with work of this character will realize by glancing at the illustrations which accompany this article the unusual nature of the difficulties that had to be overcome, especially with regard to cutting angles at nearly every section. Brown Brothers, as sub-contractors under W. P. & S. Co., are doing the field welding.

In spite of the difficulties encountered, a remarkable efficiency was attained in digging the trench. There was much speculation as to whether we could utilize a small steam shovel with a trench digging attachment, not only because of the crookedness of the narrow road, but also because the shovel had to dig off to one side along the line of its outer track. As a matter of fact we moved from 70% to 80% of the dirt by shovel and also a considerable quantity of loose rock. The trench had an average depth of 4 feet, and was 3½ feet wide, and hand trimmed, sides and bottom. The trench had to be dug right beside the cut bank and within two feet of the original concrete pipe line. This situation called for some very careful planning and skillful work in blasting, but it was carried through without accident.

The pipe was fabricated at the South San Francisco plant of Western Pipe & Steel Co. and barged to San Rafael, whence it was trucked to the job. Practically all of it was unloaded at the exact spot it would go in the line, the narrowness of the road making it impossible to yard at more than one or two places on the line.

Western Pipe & Steel Co. has shown considerable ingenuity in solving the difficulties that have arisen from time to time. Their attitude has been one of cooperation and helpful service throughout. Their product has been found satisfactory in every way.

The project is to be completed October 1.

Another sweeping curve around the head of a ravine. The pipe on the trestle is a concrete line installed in 1916 which will serve until the new steel pipe line is completed.

WELDING A FIELD JOINT, MARIN MUNICIPAL WATER DISTRICT PIPE LINE.—*This type of illustration needs no explanation. The welders are putting the finishing touches on a field joint. Working close behind them will come a crew placing soil proof wrapping over the joint.*

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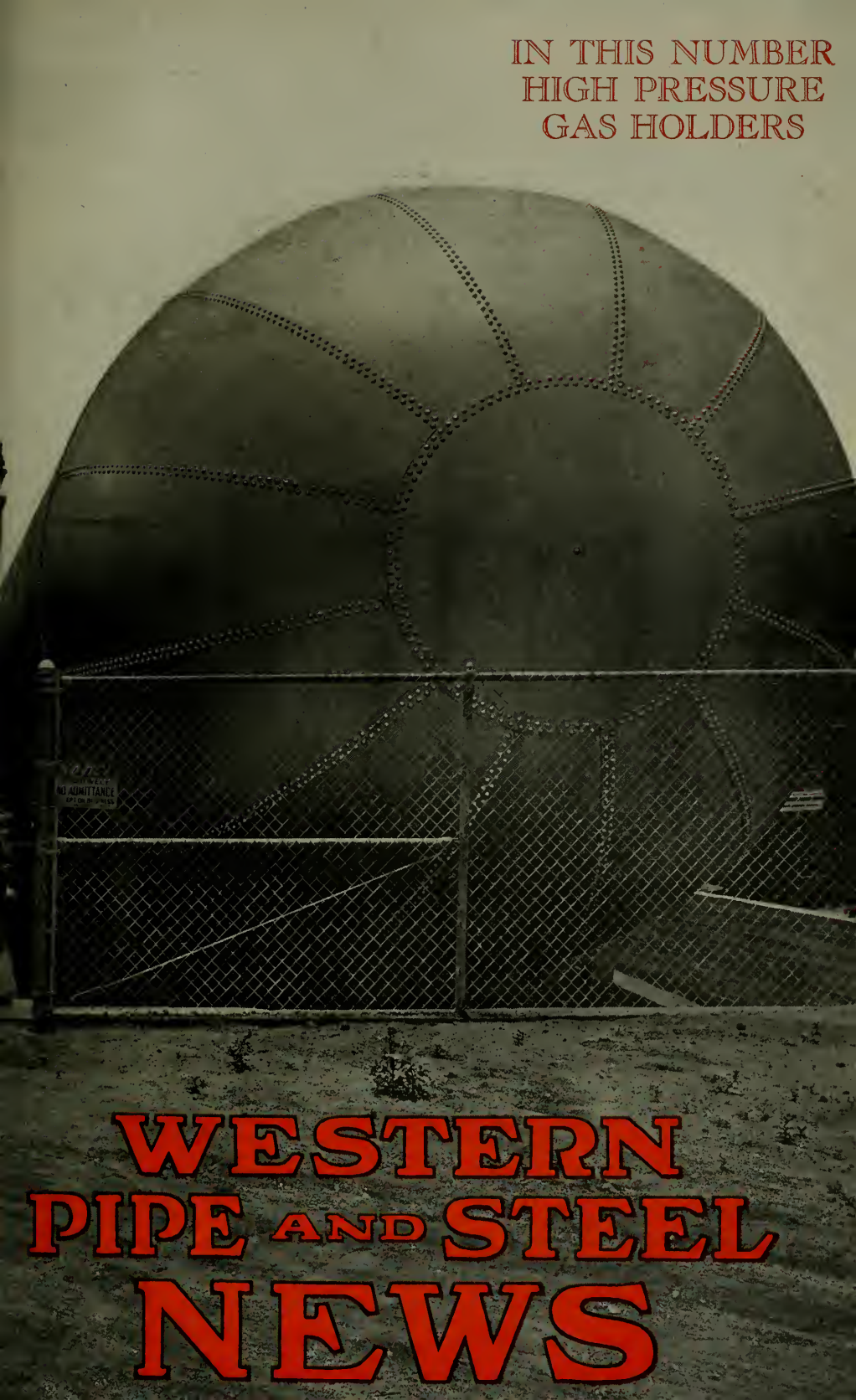
IN THIS NUMBER
HIGH PRESSURE
GAS HOLDERS



WESTERN PIPE AND STEEL NEWS

ERECTION OF HIGH PRESSURE GAS HOLDERS AT SANTA ANA.—*This is one of four holders fabricated and erected by W. P. & S. Co. for Southern Counties Gas Co. at Santa Ana. Each holder is 27' 8" in diameter, 145' 2½" long. Total net capacity between 50 pounds and 5 pounds pressure, or 3.061 atmospheres, is 250,170 cubic feet each. The shell consists of 15 cylindrical rings, of 4 plates each.*

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VOLUME III SEPTEMBER, 1926 NUMBER 7

W. P. & S. Co. Builds Twelve High Pressure Gas Holders for Southern Counties Gas Co.

By A. F. BRIDGE, ENGINEER.

IN order to lay a proper foundation for a brief discussion of the high pressure gas holders fabricated and erected for Southern Counties Gas Co. by the Western Pipe & Steel Co. of California, I should like to quote as follows from a committee report to the American Gas Association entitled "Increasing Distributing Capacities":

"If ideal distribution of gas could be obtained, there would be a miniature gas holder on every customer's premises, which would be of such size as to supply his need for gas during the demand periods, and in which the supply would be replenished when the demand ceased. The load factor on mains and services would be 100 per cent, since an equal rate of flow into the numerous holders would be going on at all times. The size of mains and services would be very small, since they would not need to be proportioned to meet any peak demand.

"These ideal conditions cannot be attained on a practical scale using so many small units, but similar conditions can be obtained by the adoption of larger units, namely, district holders."

It is obvious, in a system such as Southern Counties Gas, consisting of a number of isolated communities supplied from long transmission lines, that the reliability of service is greatly promoted by distribution rather than by concentration of storage.

This effect is not confined to actual interruption of service due to breakage of pipe lines, compressor station trouble, and so forth, as experience has shown that certain increases in loads frequently result in shortages in districts or communities remote from production sources, or where supply lines are heavily loaded.

Storage within a district provides a secondary source of supply entirely controllable by the district and instantly available.

Another important consideration in planning storage is, that eventually we will be obliged to supplement our natural gas supply with mixed or artificial gas. This probably will involve the conversion of certain districts to a mixed gas basis, and the retention of straight natural gas service in others, in order to minimize duplication of transmission facilities.

Accompanying this change there will be a progressive decline in the volume of industrial sales which at this time predominate. The domestic load, however, will be unchanged as to location except as new communities develop, and continuously increasing in quantity. Under such circumstances, the greater adaptability of distributed high pressure storage, located at domestic load centers, and consisting of multiple units at each holder station, is manifest. With a single

central holder, only one kind of gas can be stored, and changed sources of supply may render the refilling of such a holder difficult.

But with the other plan, storage will be available in each district for the kind of gas served therein, proportional to its domestic requirements, or, if necessary, two kinds of gas could be stored in a district.

The salient advantages of high pressure storage, other than saving in direct annual costs, include the following:

The peak hour send-out capacity is practically unlimited, while in the case of a low pressure holder it is restricted to the capacity of compressors, both as to pressure and volume.

A high pressure holder may be entirely discharged in one hour, if distribution main capacity permits. This feature greatly increases the flexibility of storage operation, especially in meeting unexpected or emergency peaks.

A. F. BRIDGE.

Part of the capacity of high pressure storage is available at pressures above the normal distribution pressure, which makes possible feeding secondary transmission lines direct from storage. We follow this practice at Azusa, Sierra Madre, and Orange. If conditions require, either temporarily or

The combined capacity of these four high pressure gas holders at Santa Ana is over one million cubic feet. The holders were fabricated at the Los Angeles plant of Western Pipe & Steel Co., and erected by W. P. & S. field crews.

M. R. THOMPSON.

permanently, the use of a higher delivery pressure than that designed, this is accommodated by the high pressure holders without any modification, and results only in a slight loss of capacity.

If, as will usually be the case, the abnormal pressure is required to meet the morning peak demand, there will be no sacrifice of capacity.

By way of specifically contrasting high pressure with low pressure, the following points are enumerated:

(a) High pressure holder has no moving parts, hence will not wear out or get out of order.

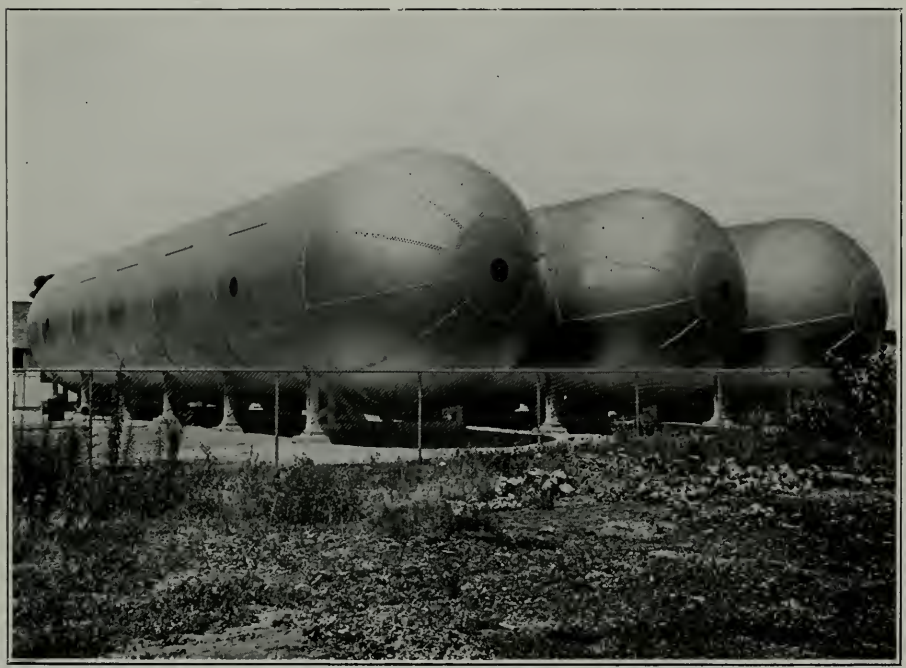
(b) Is automatic in operation and unattended, hence does not fail to function through human negligence.

(c) Can be constructed in any desired combination of sizes, arrangement of units, and ratio of height to diameter without materially affecting its cost, hence can be adapted to available sites, and rendered unobjectionable to owners of adjoining property.

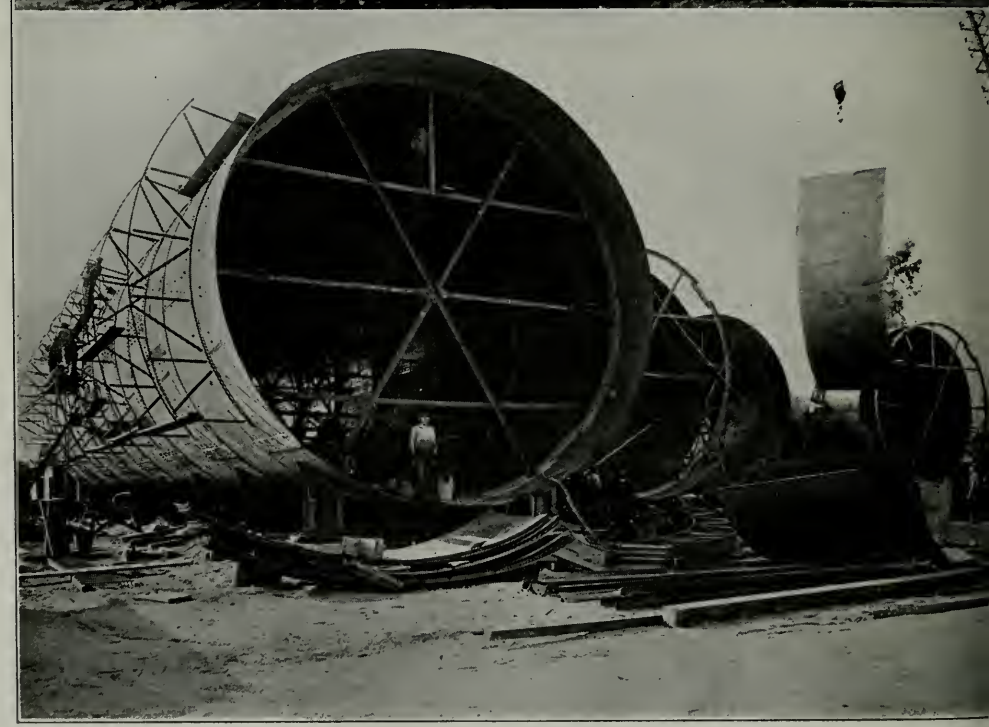
(d) Operation is not accompanied by noise, odor, or other nuisance.

(e) Does not require natural gas fuel for operation. In the face of a declining gas supply and increasing distance from source to market, which already has necessitated triple com-

(Continued on Page Seven)

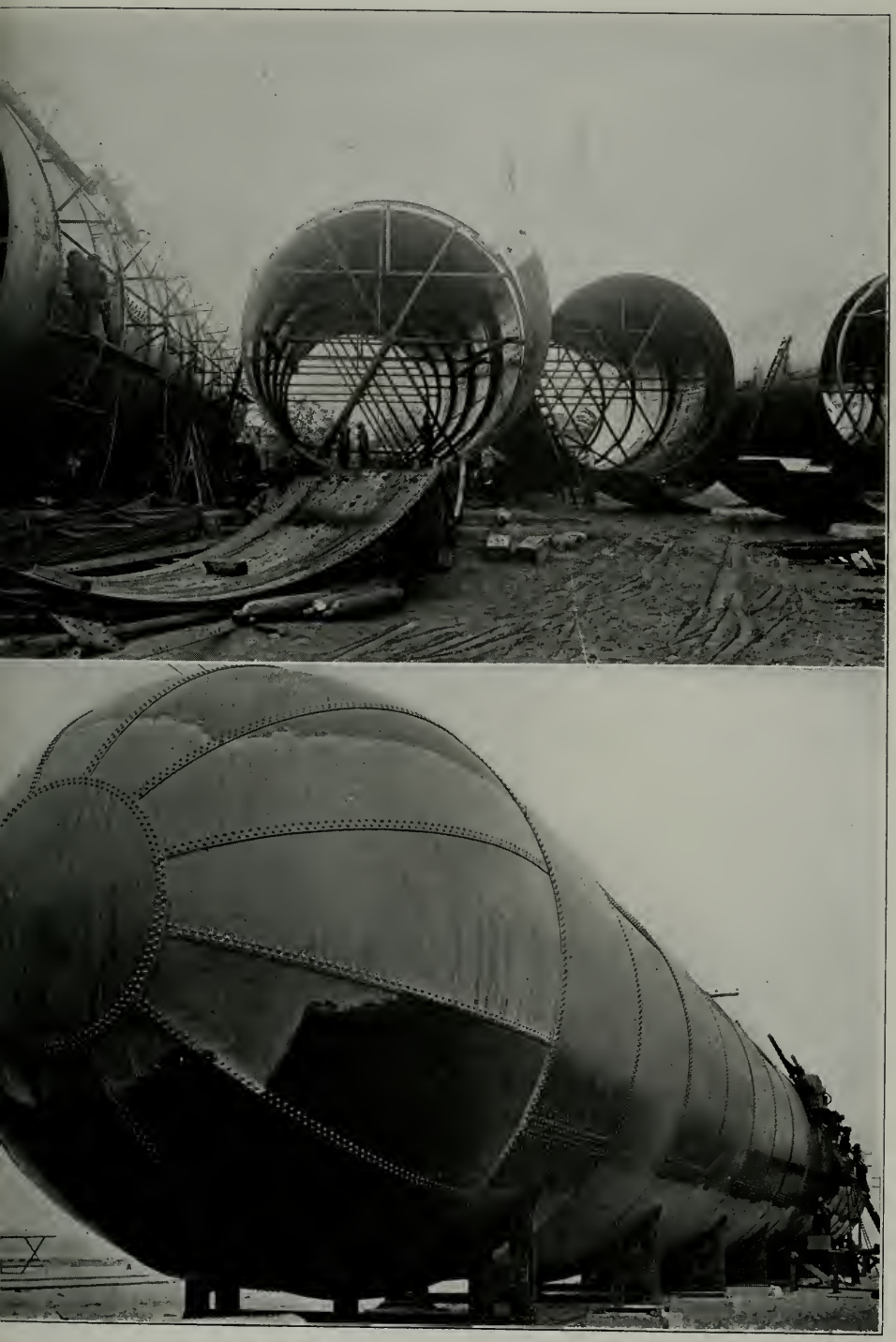


Three high pressure gas holders at Orange, Cal. Their total capacity is 230,000 cubic feet. Each holder is 20' 1½" x 107' 9" long.



PROGRESS PICTURES TAKEN DURING ERECTION OF HIGH PRESSURE GAS HO

upper left shows start of work at Santa Ana. Upper right—The same location with four holders
Lower left—In the holder at the left of this picture may be noted the method of interior reinforc
structural shapes. Lower right—In this picture the field crew is putting the finishing touches o
holder bears strikin



WESTERN PIPE & STEEL CO. FOR SOUTHERN COUNTIES GAS CO.—*Picture at uction. Attention is directed to special steel scaffolding at left on which riveters are working. lder is reinforced in the center of every alternate ring by steel spiders composed of heavy rected at Newport. The riveting details are clearly shown. Since its final painting this e to a dirigible.*

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EDITED BY EDWARD F. O'DAY

ENGINEERS and others interested in the storage of gas, both natural and artificial, will find much food for thought in the text herein on the subject of high pressure gas holders. In carrying out the work illustrated, Mr. A. F. Bridge and Mr. M. R. Thompson, engineers for the Southern Counties Gas Company, have done pioneering work of great importance.

Western Pipe & Steel Co. is proud to have collaborated with them in the solution of their problem. The illustrations tell an impressive story of the work. Mr. Bridge's article explains the economic aspects of high pressure storage.

Southern Counties Gas Company is a large and growing public utility. It serves sixty southern California cities in the counties of Los Angeles, Orange, San Bernardino, Ventura and Santa Barbara. The total population served is roughly 500,000 (all outside of the city of Los Angeles).

The company was formed in 1911 through the consolidation of a number of small companies. At that time the system totaled only 4,000 meters. Today there are over 109,000 meters, and the company has 600 employees. It draws its natural gas supply from eleven of the major fields of Southern California, handled through a network of transmission mains, of such flexibility that gas can be shifted back and forth across the territory as conditions warrant. The natural gas fields range from Ventura to Huntington Beach and include Santa Fe Springs, Signal Hill, Brea Canyon, Richfield-Placentia, Old Whittier, Coyote oil-fields, etc.

The company handles considerable industrial as well as domestic fuel. Industrial uses embrace great irrigation projects, sugar factories, pumping plants in oil-fields, and manufacturing plants of every description.

These holders are located at Sierra Madre, near Pasadena. The cover picture shows an end view of the same containers. They are 20' 1½" in diameter, 139' 6½" long, net capacity 104,800 cubic feet each.

(Continued from Page Three)

pression of gas in some cases, this feature is very important. At present the fuel required for compression of our gas at primary sources and booster stations is equivalent to more than 60% of our average domestic sales.

(f) Lastly, and possibly most important, it can be provided in increments where and when load and supply conditions may require, without adversely affecting the final cost, hence the present cost of service need not be overloaded by fixed charges on unused capacity.

These, then, are some of the economic aspects of high pressure storage, which led us to adopt it as being the most economic type of storage for installation on the system of the Southern Counties Gas Co.

The twelve units built for us by Western Pipe & Steel Co. are as follows:

At Newport, one unit, capacity 100,000 cu. ft.; at Orange, three units, 76,000 cu. ft. each; at Sierra Madre, two units of 100,000 cu. ft. each; at Santa Ana, four units of 250,000 cu. ft. each; and at Ontario, two units of 250,000 cu. ft. each, making a total installation of 2,028,000 cubic feet. This is the net capacity between the maximum working pressure and 5-pound send-out pressure.

These holders are filled from the transmission system through regulators which are set to shut off the supply of gas to the holder at the maximum designed working pressure. The gas is then delivered into the distribution system thru regulators set at required distribution pressure, so that, by simply varying the initial pressure on the transmission line, it is possible to so operate that the holder will carry any portion of the local load desired.

(Editor's Note—By way of supplementing Mr. Bridge's article on high pressure storage, we give the following data from the original specifications, for the benefit of engineers who may be interested in details of construction, etc. The specifications quoted are for the six large holders, of which four were erected at Santa Ana and two at Ontario):

This picture shows single holder erected at Newport. It is the same size as those shown on the opposite page. Note how weight is distributed on structural steel saddles.

Loads—

Dead load consists of weight of structure. Live load consists of internal gas pressure of 50 lbs. per square inch gauge and the wind pressure. Wind pressure assumed at 30 lbs. per square foot acting in any direction. Cylindrical surfaces exposed to weather calculated at two-thirds the diameter multiplied by the length.

All parts of structure proportioned so that the sum of the dead and live loads shall not cause the stresses to exceed the following:

Tension in Tank Plates, 13,750 lbs. per square inch, net area.

Tension in other parts of structure, 16,000 lbs. per square inch, net area.

Compression—20,000 lbs. per square inch (reduced according to column formulae): Shear on plates and rivets in single shear, 11,000 lbs. per square inch; shear on rivets in double shear, 22,000 lbs. per square inch; bearing on rivets, 23,750 lbs. per square inch.

Shell of Holder—

15 Cylindrical Rings.

Four plates forming each cylindrical ring. Plates 21/32 in. thick, weighing 26.78 lbs. per sq. ft. Shell plates arranged with alternate in and out rings. Circumferential seams, double riveted lap joints, ⅞ in. rivets. Horizontal seams quadruple riveted double butt joints, ½ in. butt straps, 1 in. rivets.

Hemispherical Heads—

Each head constructed of 13/32 in. plate weighing 16.57 lbs. per sq. ft. One center plate and 16 segmental plates. All seams being on circular and radial lines. Triple riveted lap joints, ¾ in. rivets.

Interior Reinforcing—

Interior of holder reinforced in the center of every alternate ring by steel spiders composed of heavy structural shapes.

Supports—

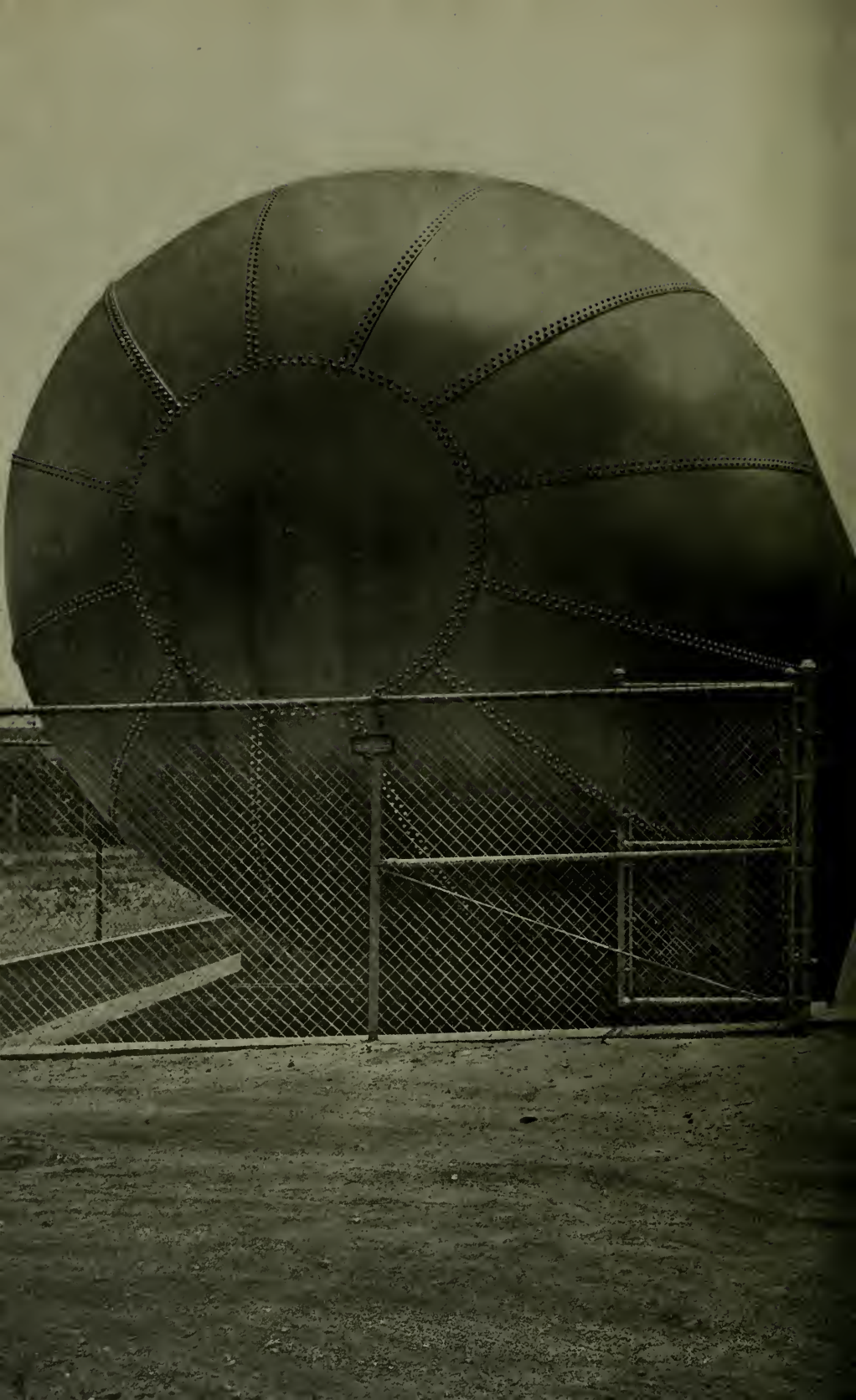
Structural steel saddles under alternate rings. Center saddles secured by anchor bolts to foundations, all other saddle frames resting on trains of rollers to provide for expansion and contraction.

Material—

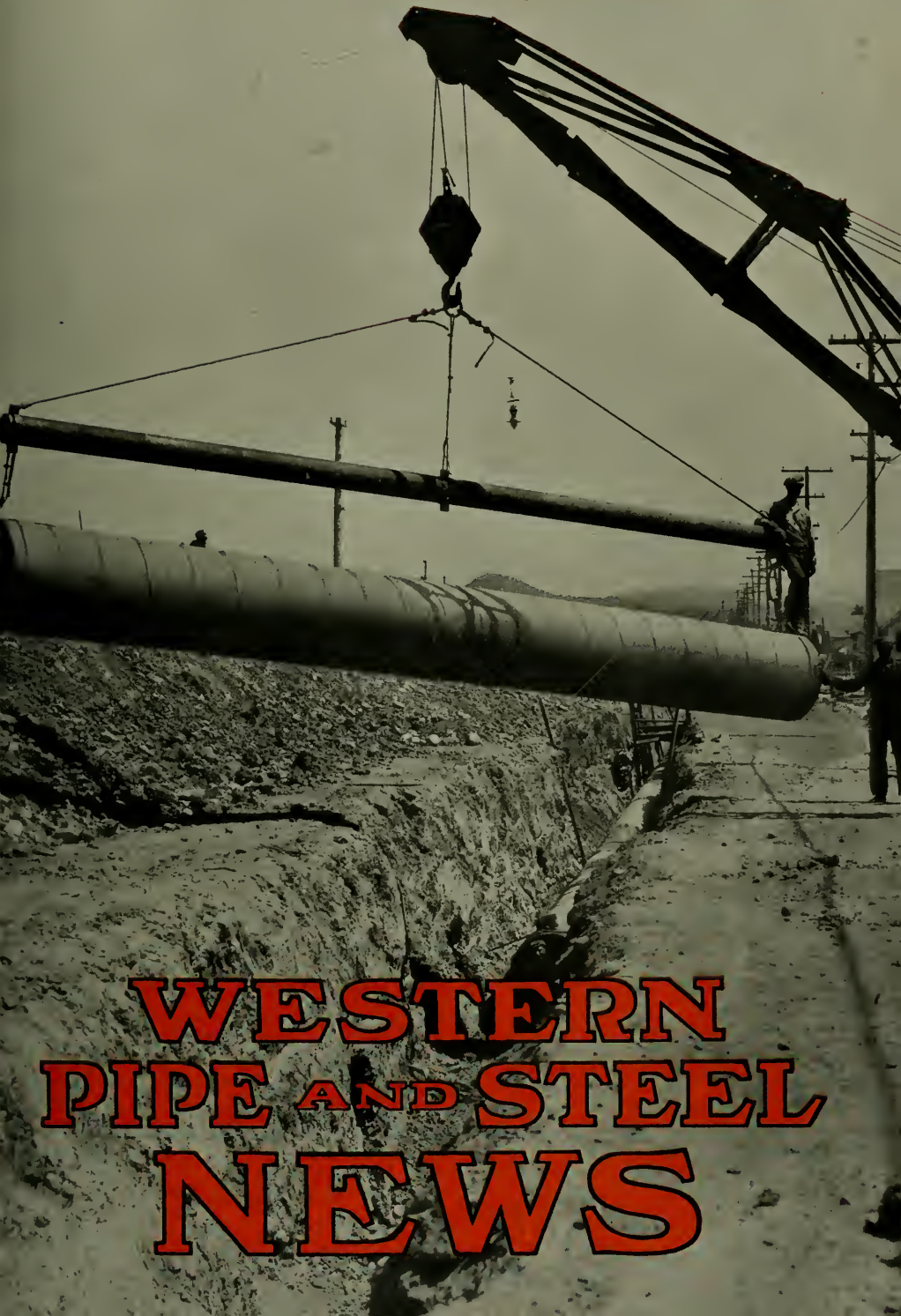
All plate and structural material entering into construction of holders conforms to manufacturer's standard specifications for Class "A" Steel, having an ultimate tensile strength of from 55,000 lbs. to 65,000 lbs. per square inch.

This picture demonstrates the sightliness of this type of gas holder. No matter where located in a community they are so inconspicuous that one does not become aware of their presence until one is upon them.

TWIN HIGH PRESSURE GAS HOLDERS ERECTED BY W. P. &. S. CO. AT SIERRA MADRE.—*These containers, which look not unlike "blimps," are 20′ 1½″ in diameter and 139′ 6½″ long. The total net capacity between 40 pounds and 5 pounds pressure, or 2.381 atmospheres, is 104,800 cubic feet each. The shell consists of 15 cylindrical rings of 3 plates each.*



Pre-Convention Number
American Water Works Association
California Section
San Diego, October 28-30



WESTERN PIPE AND STEEL NEWS

SAN DIEGO INSTALLS 17 MILES OF LOCK-BAR STEEL PIPE.—*Extending from the Riverview pumping plant to University Heights reservoir, the city's central distributing point, this line forms a notable addition to the transmission system. Its capacity is 10,000,000 gallons daily.*

Western Pipe and Steel News

PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME III OCTOBER, 1926 NUMBER 8

An Outline of San Diego's Water Supply, Past, Present and Future.

By F. A. RHODES, CITY MANAGER.

[EDITOR'S NOTE.—This article was prepared especially for Western Pipe & Steel News, for the information of delegates attending the annual convention of the American Water Works Association, California Section, at San Diego, October 28, 29 and 30.]

"SAN DIEGO is important historically as being the oldest Pacific Coast settlement within the present United States. The bay was discovered, September 28, 1542, by Juan Rodriguez Cabrillo, a Portuguese navigator in the service of Spain, who named it San Miguel. In 1602 it was again entered by Sebastian Vizcaino, on November 12, the day of St. James of Alcala, after whom he renamed the bay San Diego (St. James). For 167 years no permanent settlement was attempted by Spain; but in 1769 a joint sea-and-land expedition was sent out from Lower California. The first ship arrived April 11; the first land party in June; and on July 16, Father Junipero Serra dedicated on Presidio Hill, in what is now Old Town, the first of his 21 Missions.

"San Diego was first incorporated as a city in 1850 and its first newspaper issued in 1851. In 1867 Alonzo E. Horton of San Francisco, the real founder of modern San Diego, purchased from the city trustees a tract of 960 acres on the present site of the business district for an aggregate sum of $265, or approximately 27 cents an acre. . . . By 1870 the number of buildings was 439. . . . San Diego's second "Great Boom" came in 1886-88, following the completion of the Santa Fe Railroad system. Extensive public and private improvements began and the population increased in 1890 to nearly 17,000."

The above quotation from Rider's California serves the double purpose of furnishing a historic background for what is to follow, and laying the foundation for a proper understanding of San Diego's water problem, the explanation of which lies fundamentally in the story of its population growth.

Taking the federal census as a basis of comparison, we find that the city was credited with 17,700 inhabitants in 1900, 39,578 in 1910, and 74,683 in 1920. By 1925, according to the estimate of the United States Census Bureau, population had passed the 106,000 mark. Conservative estimates based on the usual factors place the present population at more than 140,000. These figures tell something of what the problem has been to keep San Diego's water supply abreast of its phenomenal growth. Without going into the remote past, the mere fact that population has almost doubled since the census of 1920, shows what we have been up against.

No attempt will be made here to go into the topographical, geological, and other conditions that exist in the extreme southwestern corner of the United States, as they are more or less familiar to Western engineers. Neither will it be possible to discuss the long litigations, the water right situation and riparian land ownerships which have complicated our problem.

However, a brief description of the topography of this county may not be out of place. San Diego county is characterized by, first, a series of mesas rising from the shores of the Pacific, and extending from ten to twenty miles inland to elevations of 1200 feet; second, a rugged, mountainous area extending from the mesas eastward to the Imperial Valley. Much of this area rises to 4,000 feet or more, while the higher peaks are over 6,000 feet. The normal annual rain-fall in the county varies from nine to ten inches along the coast, to fifteen and even twenty on the mesa, and reaching as much as 40 inches in the higher mountains. The well-defined regularity of recurring dry cycles—generally nine years followed by a year of high flood runoff—makes the problem of utilizing every available resource, center around the construction of reservoirs to store the water when it is available.

The city began to take over its own water supply and problem in 1901 when it bought out the Consolidated Water Co.'s holdings within the city limits. Prior to this time two companies representing private interests had begun the development of ambitious water projects, which contemplated reservoirs in the southern part of the county at Morena, Marron, Upper and Lower Otay and the Barrett sites. Work was carried on at all of these reservoirs except the Marron site. By 1906 the water problem was so acute that a consolidation of the two companies properly financed was affected under the name of the Southern California Mountain Water Co. The new concern contracted to deliver water to the city, which relieved the situation temporarily, but continued population growth soon compelled further action. By 1909 the Dulzura conduit was completed, to bring water from Cottonwood Creek to Lower Otay reservoir by way of Dulzura creek, and this additional supply gave the city a total net yield of 5,870,000 gallons daily. Immediately after this, it was found necessary to complete the Morena

This view of Lock-Bar fabrication shows the plate passing through the rolls, a section assembled, another drawn up with clamp rings, and third entering the hydraulic press.

Dam, which was finished in December, 1912. This brought the water supply up to 7,570,000 gallons daily, at the beginning of 1913, when the population was estimated to be nearing the 50,000 mark. Meantime the city had taken over the company's entire water system except Morena Dam and the lands connected therewith. These were finally taken over in 1914.

The city had now begun developing its water supply with an eye to future needs and several bond issues were voted. A pumping plant was installed in Mission Valley which brought the supply up to 8,770,000 gallons daily. Further developments in 1915 brought the supply up to 9,890,000.

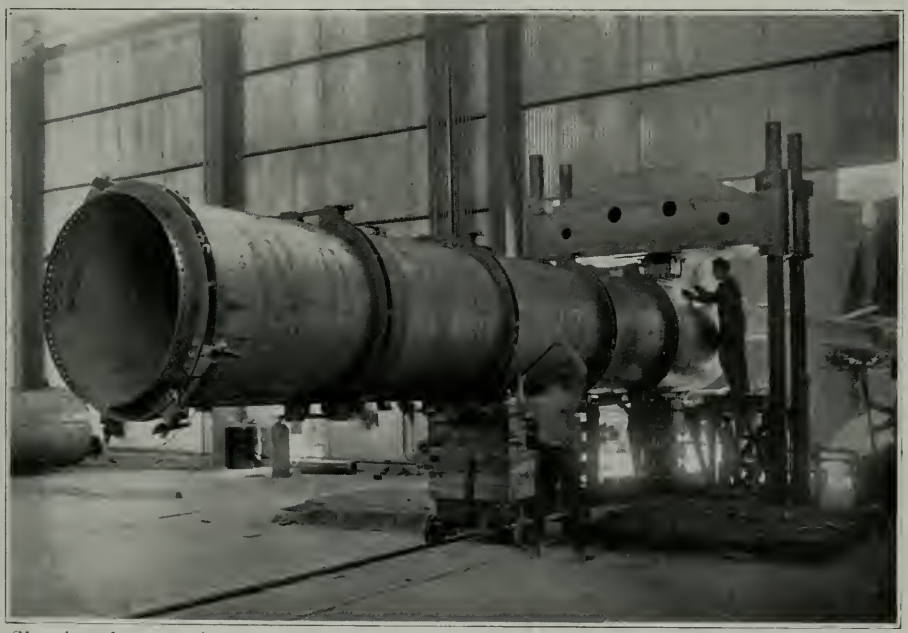
The unprecedented flood runoff of 1916 destroyed the Lower Otay dam and reservoir and did considerable damage to the transmission system. This was a great setback, as it reduced the available supply by 2,400,000 gallons daily. Lower Otay was rebuilt larger than before and when completed in October, 1919, brought the net yield up to 10,720,000 gallons daily.

Even this did not provide enough margin for the rapidly growing city and again immediate further development was the problem. While reservoir sites were being studied and the proposed location of various dams investigated, an agreement was entered into in January, 1920, for a supply of 3,000,000 gallons daily from the Lake Hodges reservoir of San Dieguito Mutual Water Co. (In 1925 the city acquired the entire San Dieguito System.) This added 3,000,000 gallons, bringing the supply up to 13,720,000 gallons daily.

In 1923 Morena dam was raised ten feet, increasing its capacity by 520,000 gallons daily and bringing the supply up to 14,170,000 gallons daily. In 1924 a plan for reclaiming wash water from the Lower Otay filtration plant added 300,000 gallons daily to the city system.

When East San Diego came into the city proper, its water supply of 1,000,000 gallons daily from the Cuyamaca

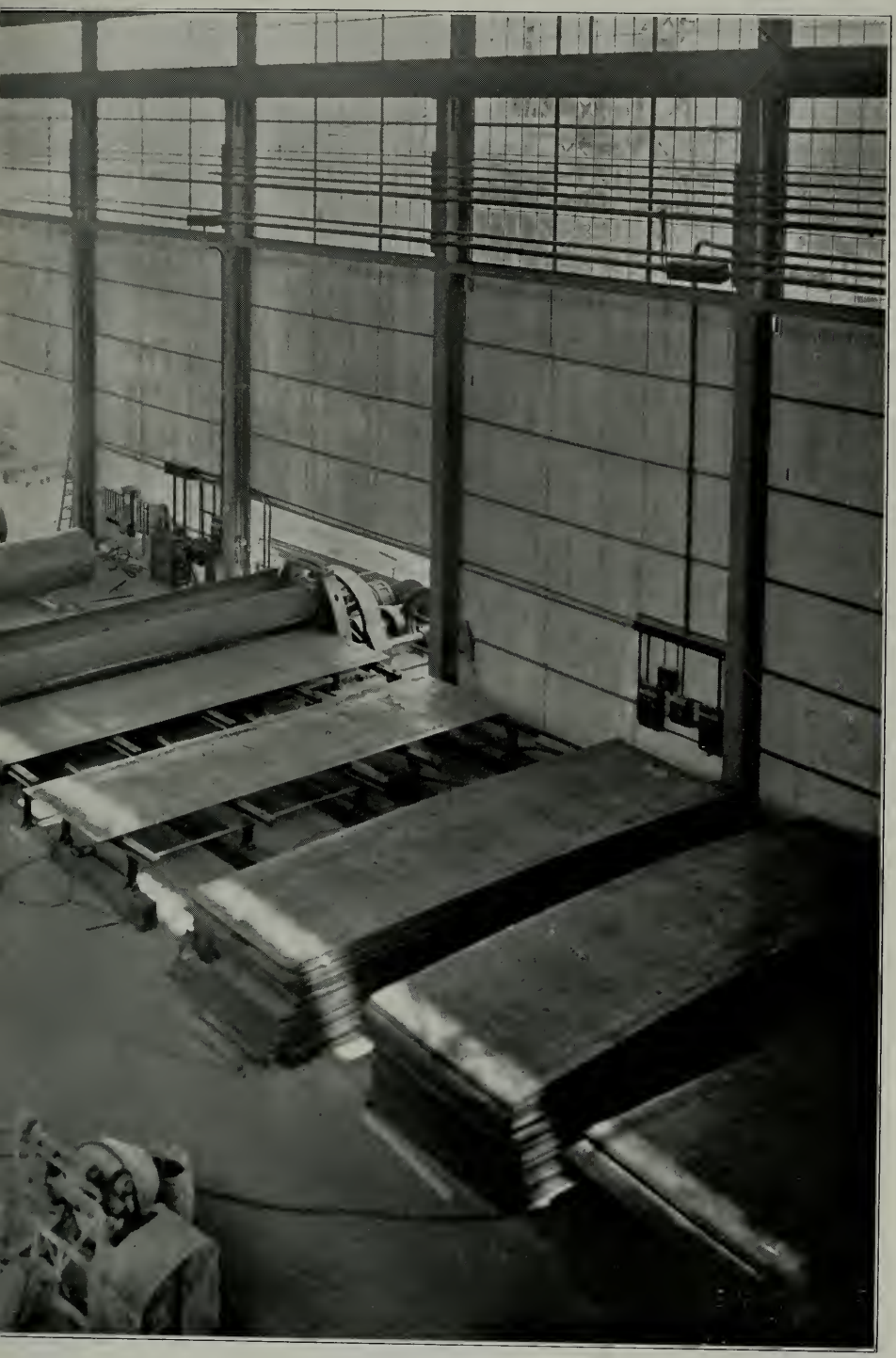
(Continued on Page Seven)



Showing the operation of pressing the longitudinal Lock-Bar seams. The hydraulic press exerts a pressure of 350 tons per lineal foot of pipe.

GENERAL VIEW OF LOCK-BAR FABRICATION DEPARTMENT, SOUTH SAN FRAN

layout of Lock-Bar manufacture. At the extreme right are piles of plates that have passed thr the rolls. After being rolled into semi-circular form the halves and Lock-Bars are assembled, an the hydraulic press, which presses the longitudinal seams. On the floor beyond are two comple kettle and wrapping machine. The long spur track inside the building at the left provides direc



ANT, WESTERN PIPE & STEEL CO.—*This comprehensive picture shows the straight-line illing machine, bevel shears, upsetting machine and crimping machine and are ready to enter on up with heavy steel clamps. In the middle distance is seen a section half way through next to the testing machine. Beyond this point are installed the preheating oven, the dip cilities.*

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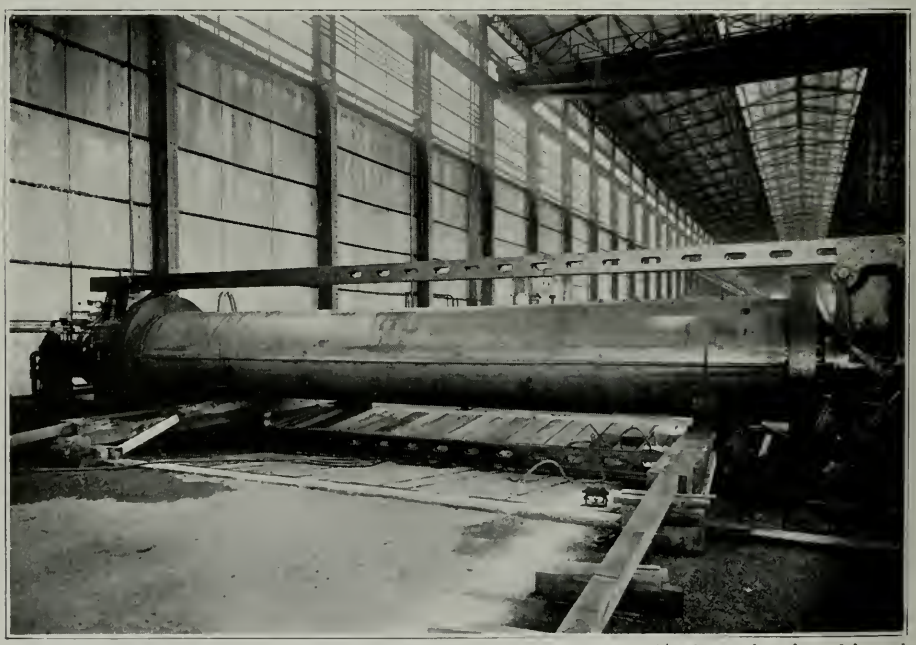
5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

WESTERN Pipe & Steel Co. of California takes pleasure in dedicating this issue of the *News* to members of the American Water Works Association, California Section, whose seventh annual convention will be held at San Diego, October 28, 29 and 30.

That these yearly meetings of engineers, superintendents and other officials interested in the storage, transmission and distribution of water are productive of lasting benefit to all who attend is obvious. The mere fact that the convention constitutes an open forum for the interchange of ideas, the reporting of experiences, and the solution of problems peculiar to the business, accounts for the increasingly large attendance and interest in the deliberations.

Also important is the educational value of the exhibits of the various equipment manufacturers. This company feels that its exhibit this year is unique, in that, besides the usual showing of products, it has under construction for the city of San Diego a 17-mile line of Lock-Bar steel pipe which might justly be termed Exhibit A of the convention.

Incidentally we would like to draw special attention to the illustrations herein covering various stages of the fabrication of Lock-Bar Steel pipe. Although Lock-Bar pipe has been known on this coast for many years (Portland installed a 24-mile line back in 1910) and several cities are using it to their satisfaction, not every engineer is familiar with this method of pipe construction. For this reason we are showing detailed shop views, including close-ups of different operations, which we feel will be of interest. What we like to emphasize is that the Lock-Bar joint is as "strong as the plate itself."



Section of Lock-Bar pipe undergoing hydraulic pressure test. Each section is subjected to a test of 1½ times the maximum working pressure.

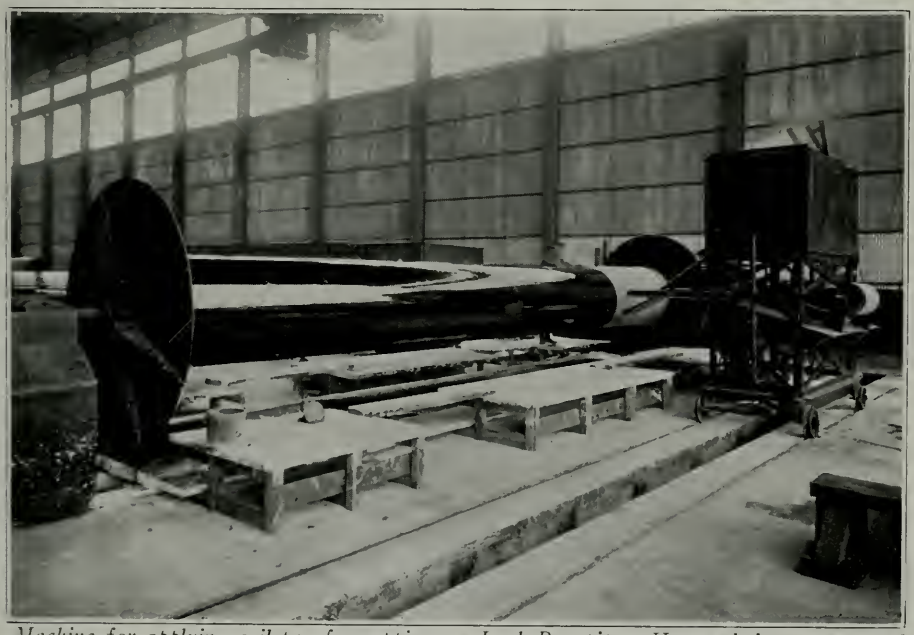
(Continued from Page Three)

Water Co. became an additional factor so that, by the end of 1925, the total available yield was 15,470,000 gallons daily.

The 1926 program consists of the construction of the El Capitan pipe line, originally designed to extend from El Capitan reservoir, some 25 miles east of the city, to University Heights reservoir, the central distributing point of the city system. However, present construction contemplates the completion of the line between the reservoir and Lakeside, about 17 miles.

This line consists of 36-inch Lock-Bar steel pipe, supplied by Western Pipe & Steel Co. of California, and fabricated at their South San Francisco plant. The line is buried at all places except where it is carried on concrete piers across canyons. The pipe is dipped and then spirally wrapped with "Western" special felted fabric saturated with bituminous compounds, which renders it soil-proof. Wrapping is bonded to the pipe by heated asphaltum flowing between the covering and the pipe during the wrapping operation. The pipe sections are 30 feet long and the field joints are riveted. Pipe laying began early in September and, although the contract completion date is March 1, 1927, we find that Western Pipe & Steel Co. has its production facilities so well organized, and their field operations are proceeding so rapidly, that the pipe line will more than likely be completed far ahead of schedule.

It may be said that in installing Lock-Bar steel pipe, San Diego is following the example of many other municipalities which have found this type of steel pipe construction to be the best. The Lock-Bar principle gives a joint so strong that the steel plate itself will break before the joint will give away. A survey of other cities shows that hundreds of miles of Lock-Bar steel pipe have been installed in this country in the last few years. A notable example is the city of Portland, Ore., which recently installed 25 miles of 50- and 58-inch pipe which delivers 74,000,000 gallons of water



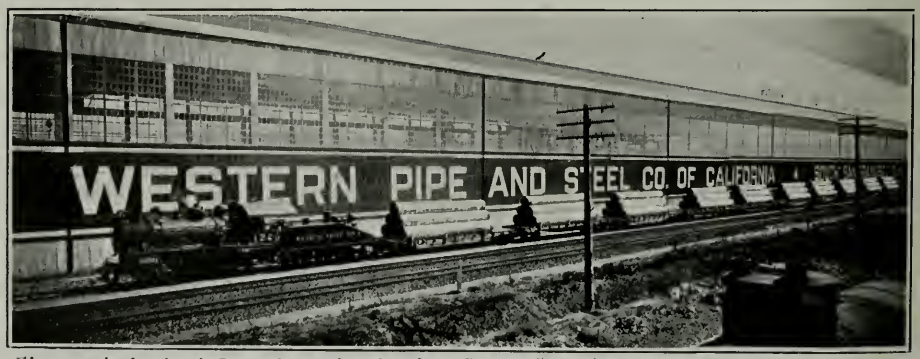
Machine for applying soil-proof wrapping on Lock-Bar pipe. Hot asphaltum compound flows between the wrapping and the pipe while turning.

per day, while the estimated delivery was for 63,000,000 gallons. Portland's entire water supply is carried in Lock-Bar pipe. Back in 1909-10, Portland installed 24 miles of Lock-Bar steel pipe, and the success of this line brought about last year's additional 25-mile line of Lock-Bar. Other cities that have installed large quantities of Lock-Bar pipe include Boston, Cleveland, Detroit, Philadelphia, Brooklyn, Omaha, Montreal, St. Louis, Rochester, Akron, Jersey City, Minneapolis, Seattle, Vancouver and Winnipeg.

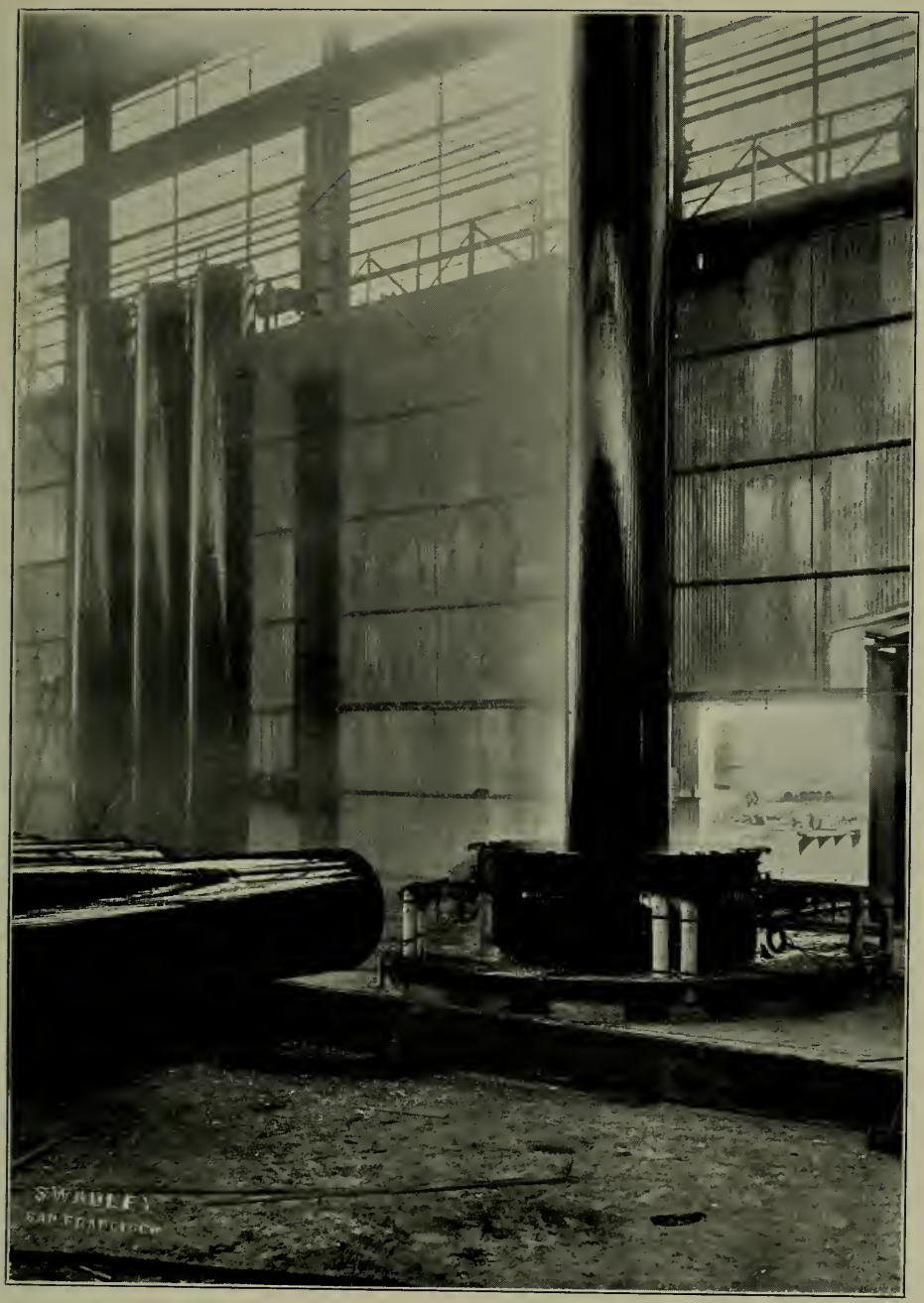
San Diego's new pipe line will be utilized immediately to serve as a transmission line from the pumping plant at Riverview, about one and one-half miles from the Lakeside end of the El Capitan pipe line. This plant will be supplied by a battery of ten wells, each equipped with a deep well turbine and all discharging into a sump. The ten wells are expected to yield 10,000,000 gallons daily during peak demands, or an equivalent of at least 1,000,000 gallons per day annually, which will adequately take care of current demands for additional water.

For the future, what is known as the "Rhodes Plan" provides for extensive developments in water storage sufficient to meet the requirements of a population of 500,000. Incidentally it may be pointed out that a population curve, based on a study of Los Angeles' growth, indicates that San Diego may reach 500,000 by the end of 1945. If it does, and if meantime the "Rhodes Plan" has been carried out with the necessary bond issues, etc., the water supply will be developed for that population.

One of ten of the Riverview wells which will augment San Diego's water supply.



First train-load of Lock-Bar pipe leaving South San Francisco plant for San Diego. Six 30' sections of pipe were loaded on each car.



A 30′ SECTION OF LOCK-BAR PIPE COMING OUT OF THE DIP KETTLE.—
Against the wall are three sections cooling, while those lying on the runway are on their way to the wrapping machine, to receive the soil-proof covering.

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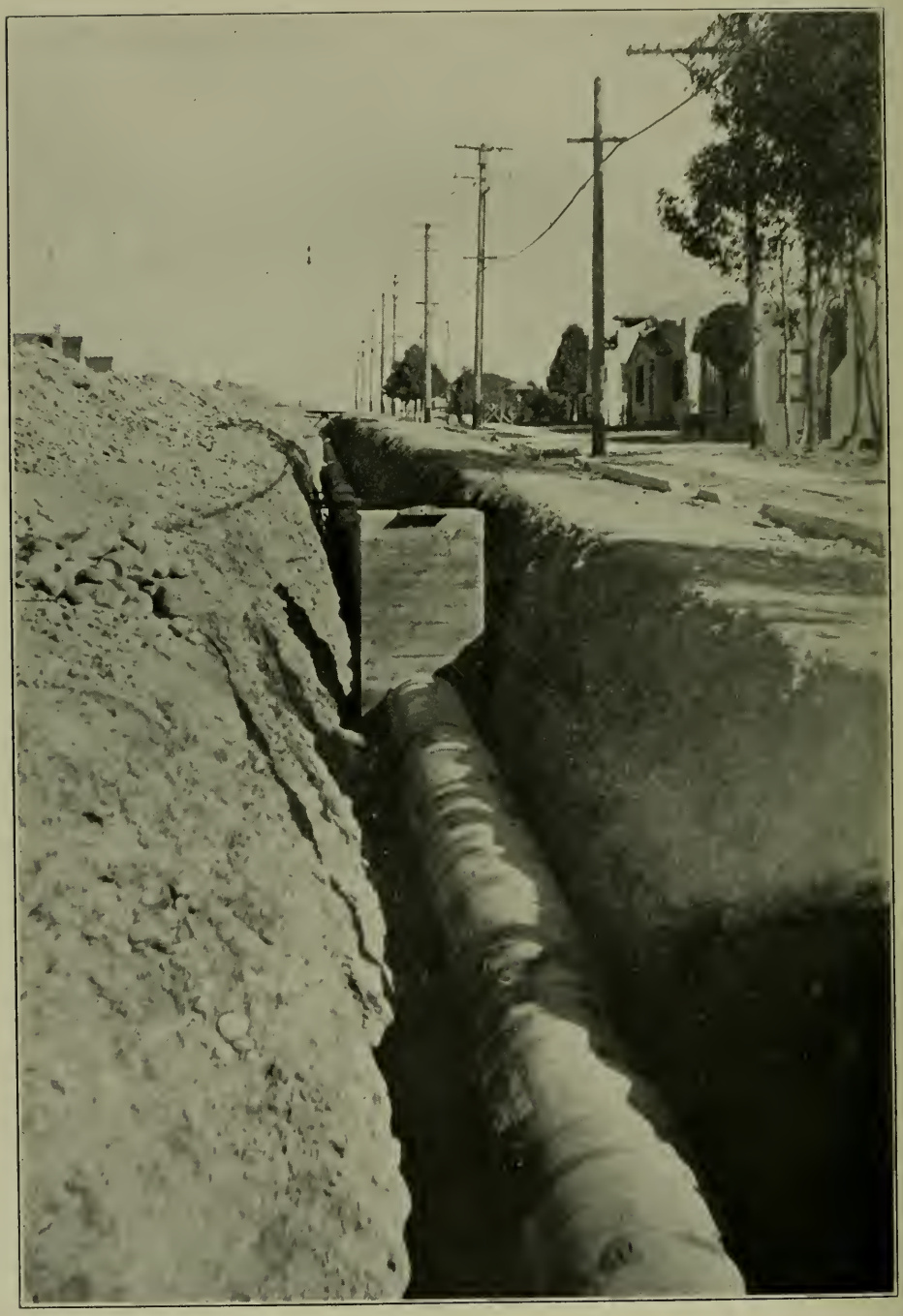
WESTERN PIPE AND STEEL NEWS



SAN DIEGO'S EL CAPITAN TRANSMISSION LINE ALONG MEADE AVE.—
This line consists of seventeen miles of thirty-six inch diameter Lock-Bar steel pipe with a carrying capacity of ten million gallons of water daily.

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VOLUME III NOVEMBER, 1926 NUMBER 9

Some Notes on Lock-Bar Installation, El Capitan Pipe Line, San Diego

By F. A. RHODES, City Manager

FOLLOWING my article in the October number of *Western Pipe & Steel News*, which outlined San Diego's water supply, and described in some detail the installation, now under way, of seventeen miles of thirty-six inch Lock-Bar steel pipe for the El Capitan transmission line, it seems appropriate to give an account of our actual field experiences with this type of steel pipe. It is all the more appropriate to do this, for the reason that so many of those who attended the recent convention at San Diego of the California Section of the American Water Works Association, showed a keen interest in both the exhibit of Lock-Bar pipe by the Western Pipe & Steel Co. adjoining the convention hall, and in the field operations, which many visited.

It is therefore with pleasure that, at the request of officials of the Western Pipe & Steel Co., I offer the following data on Lock-Bar installation for the benefit of engineers and other interested water works officials:

On turning back to my January, 1926, number of *Western Pipe & Steel News*, in which the Western Pipe & Steel Co. made official announcement that it had completed arrangements whereby it became the exclusive manufacturer of Lock-Bar steel pipe for the Pacific Coast, I find the following paragraphs included in a technical description of Lock-Bar pipe:

"All Lock-Bar pipe is made up in sections approximately thirty feet long so that the number of field joints is kept at a minimum. The field joints are usually riveted lap joints. Each pipe section is slightly tapered, so that the small end of one section fits easily into the larger end of the adjacent section. In this way fitting up in the field is accomplished without difficulty."

"Angles up to five degrees may be taken in the pipe joints by proper manufacturing in the shop. On long radius bends, short pipe sections may be made up and a series of five degree angles may be taken in the successive joints, thus taking care of a sharp change in direction without the necessity of making up riveted specials."

Our experience confirms the statements in the foregoing paragraph in respect of making alternate short sections with angles in successive joints, rather than resorting to the manufacture of a large number of specials.

While it is probably true of all steel lines it is particularly true in the case of Lock-Bar lines, that in making reverse curves it is a much better practice to allow a short tangent of at least one section between the curves, if possible. In fact, it may be emphasized that every effort should be made to reduce the number of curves in the line. This statement applies to short curves that require "specials." Long easy curves do not make a great deal of difference, but "specials" must fit very accurately, and the creeping of the pipe, together with the natural expansion and contraction sometimes makes this difficult.

Our experience has indicated quite conclusively that the full bottom width of the ditch should be maintained in all places, and particularly in the vicinity of short curves. In fact, it will often save considerable time and annoyance if a little extra width is given in these places. We have also found from experience that it is well to figure on excavating at least 6 inches deeper than the flow line, or bottom of the pipe in rocky ground that has been blasted, and where sharp projections occur which may abrade the soil-proof covering, so that a bed of soft material can be prepared on which to lay the line. Furthermore, under these conditions, the dirt from the bell holes, which of necessity are excavated by hand, can much more readily be thrown back along the bottom of the ditch than to the top, which is often some distance.

It has been found that the question of preparing bell holes any considerable distance in advance of the pipe laying is open to more or less discussion. A certain amount of creeping in the line is naturally unavoidable, and while the bell holes may have been spotted very carefully with some allowance for creepage, weather conditions and temperatures may so vary that in the course of a half mile or so the joint will come on the wrong side of the bell hole for caulking, or even miss it altogether. This necessitates rather difficult excavation to again prepare the hole so that the joint can be caulked, and in general causes more or less trouble. In the building of concrete piers that are to carry the pipe line across canyons or ravines on a curve, it is suggested that the piers be built to a distance of about two feet below the flow line and that the pipe be placed on blocks as it is installed. After the completion of the line in every detail, the tops of the piers and the saddle can then be readily poured at much less expense than would be incurred in trying to fit a line of piers built complete beforehand. Where the line is to be laid on trestles located on curves, instead of on concrete piers, some sim-

El Capitan pipe line approaching University Heights reservoir, San Diego. The test head is only a few feet from the reservoir embankment.

ilar provision should be made for seating cradles after the completion of the line.

The photographs in this issue of *Western Pipe & Steel News* should be of interest to all who have been, or expect to be concerned with pipe line installations, particularly if the line happens to be of Lock-Bar steel pipe. The large view in the center spread of the magazine, showing reverse curves carried across a ravine on concrete piers, I consider an unusually striking pipe line photograph. While most of these illustrations are reproduced from pictures taken by Western Pipe & Steel Co.'s staff photographer, some of them are enlarged from kodak pictures made by our engineers, to show the different details of construction that might be of interest.

The whole idea back of this article was that of presenting a few suggestions that might prove helpful in planning and executing the work of installing Lock-Bar steel pipe lines. In closing I should like to express my appreciation for the splendid cooperation we are receiving from the Western Pipe & Steel Co. of California, from the management right through to the field crews that are placing the pipe in the trenches.

Convention Impressions

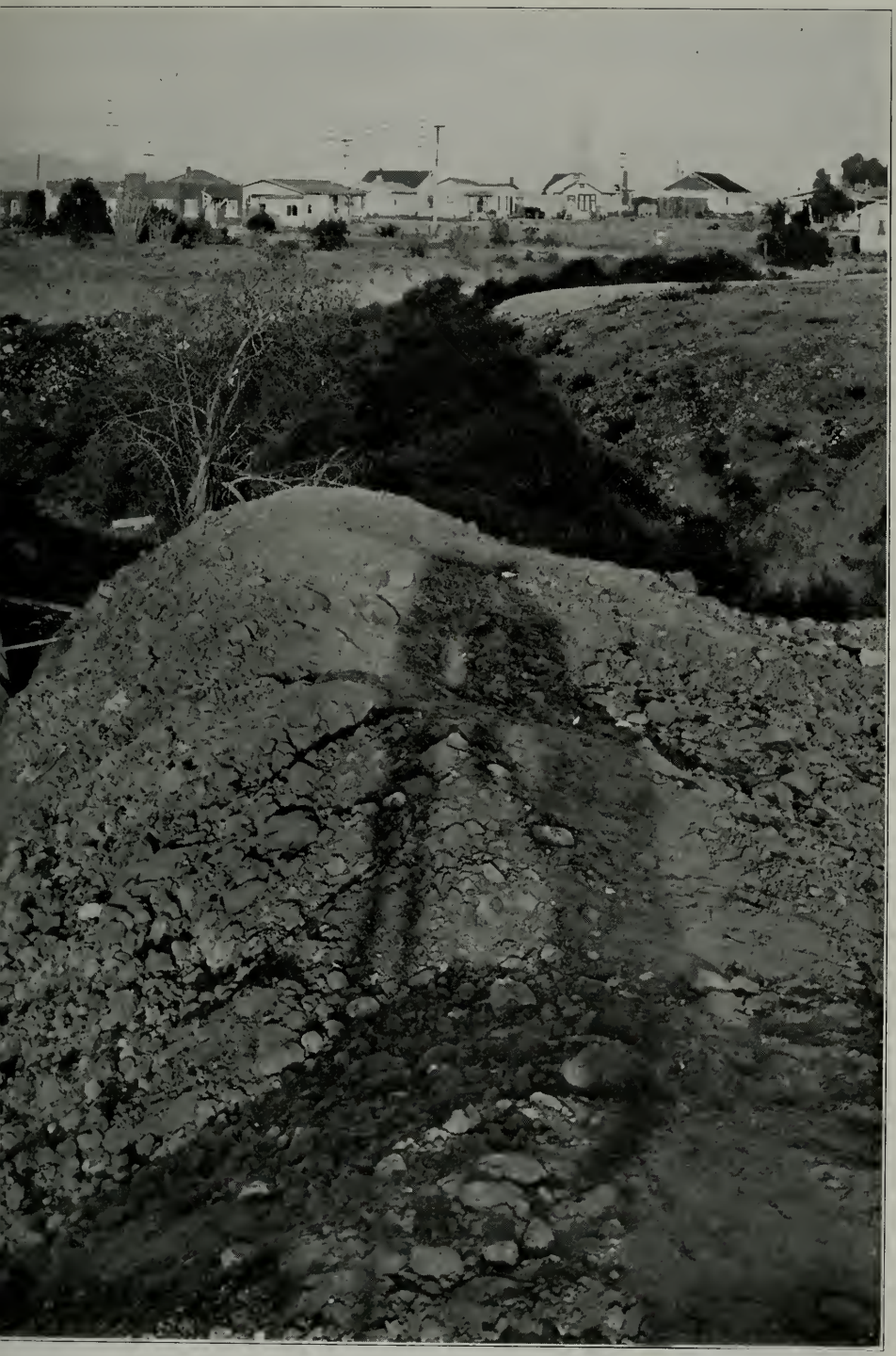
THIS magazine seldom departs from its fixed policy of keeping its readers in touch with progress of the fabrication and installation of steel products, but this year's convention of the California Section of the American Water Works Association at San Diego was such an outstanding success that it seems fitting to include here a few words regarding it.

It was the unanimous verdict of delegates and exhibitors alike, that this was the most successful gathering in the history of the organization. So much real constructive work was accomplished, and it was all done in such a spirit of good fellowship and mutual

(Continued on Page Seven)

At this place the new San Diego pipe line passes around a high bluff. The bank at right shows type of soil encountered.

THIS VIEW SHOWS SOME OF THE REVERSE CURVES IN SAN DIEGO'S NE
connect the Riverview pumping station with University Heights reservoir, but none more
Western Pipe & Steel Co. of California is fabricating this Lock-Bar pipe at its South San
crossing ravines such as this. The entire line is wrapped with soil proof covering.



.—There are many interesting and unusual features in the seventeen-mile pipe line that will this, where the pipe is carried across a ravine in a series of reverse curves, on concrete piers. nt and "Western" field crews are installing the line. The pipe is buried at all places except

Western Pipe and Steel News
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EDITED BY EDWARD F. O'DAY

WITH this and two earlier numbers of *Western Pipe & Steel News*, we feel that we have given a fairly adequate presentation of Lock-Bar steel pipe for the information of engineers and water works and municipal officials. Other Lock-Bar projects are yet to be presented to our readers, but for the present the three numbers of this magazine that have been devoted to the description and illustration of Lock-Bar pipe will be found to cover the subject rather thoroughly.

The January number of this year, announcing Western Pipe & Steel Co. as exclusive manufacturers of Lock-Bar pipe on the Pacific slope, contained considerable technical data on the principles of Lock-Bar construction, and listed many of the major installations of Lock-Bar in this country in the last five or six years.

The October issue, which was a pre-convention number for the American Water Works Association session at San Diego, illustrated in detail the various steps of fabrication in our shops, of Lock-Bar pipe for the City of San Diego, with a description of the project.

In this post-convention number, we reproduce a large number of interesting field pictures, taken at points on the line visited by delegates during their stay at San Diego. Those who were not able to view the field installation, saw the 30 foot section of Lock-Bar pipe in our convention exhibit, illustrated on this page.

Those further interested will find additional data, including tables of weights, tests, working pressures, etc., in Section Eleven of our General Catalogue 26, pages 105-112, issued a short time ago.

This picture shows Western Pipe & Steel exhibit at the San Diego convention. The thirty-foot section of Lock-Bar pipe with soil proof wrapping attracted much attention.

(Continued from Page Three)

understanding, that the cumulative benefits will manifest themselves for a long time to come.

Such conventions have an importance and an effect upon those who attend them that is incalculable. This convention in particular was one of the most intimately human we have ever attended. In point of numbers it was relatively small, although the largest ever assembled by this association. The fact that the membership does not run high into the hundreds, perhaps accounts for the intensely human feeling that prevailed.

This intimacy afforded an opportunity to learn and understand not only the other fellow's viewpoint, but also an opportunity to learn the other fellow himself.

There were three major phases of the convention, all of them successful far beyond the average: the official convention sessions, the exhibits, and the social activities.

Over and above all these was the city of San Diego acting as host—and it was host par excellence—through its officials and citizens. To sum up the convention—the sessions were the most interesting and, therefore, the most beneficial; the exhibits were the most elaborate and, therefore, of the greatest educational value; and the social arrangements were the most perfect in the annals of such gatherings. San Jose, which will have the convention next year, has, indeed, a mark to equal.

According to the official records of the convention there was an increase of sixty per cent in attendance and also in exhibits over last year's convention, and in fact over all previous sessions.

The following officials were elected to serve for the ensuing year: Chairman, S. B. Morris of Pasadena, succeeding C. B. Jackson; Vice-Chairman, J. J. Ryland of San Jose; Secretary-Treasurer, Paul E. Magerstadt of Oakland, re-elected; Executive Committee, P. Dietrich of Glendale and John Burt of San Rafael.

Three notables inspecting the line. Right to left—Mr. Arthur Powell Davis, Consulting Engineer; Mr. Fred A. Rhodes, City Manager, San Diego; and Mr. Robert F. Cowles, Engineer in Charge.

A close-up view of the El Capitan line crossing a ravine on concrete piers. The field joints have not yet been wrapped with soil proof covering, as final test has not yet been made.

View looking east along Meade Ave., San Diego, showing Lock-Bar pipe distributed along the line, trench excavated but not trimmed, and spoil bank which extends all the way to the left hand curb.

INSTALLING LOCK-BAR PIPE ON CONCRETE PIERS ACROSS A RAVINE.—*This picture was taken during the field operations at San Diego. A specially constructed extension was placed on the derrick to handle pipe sections in this locality.*

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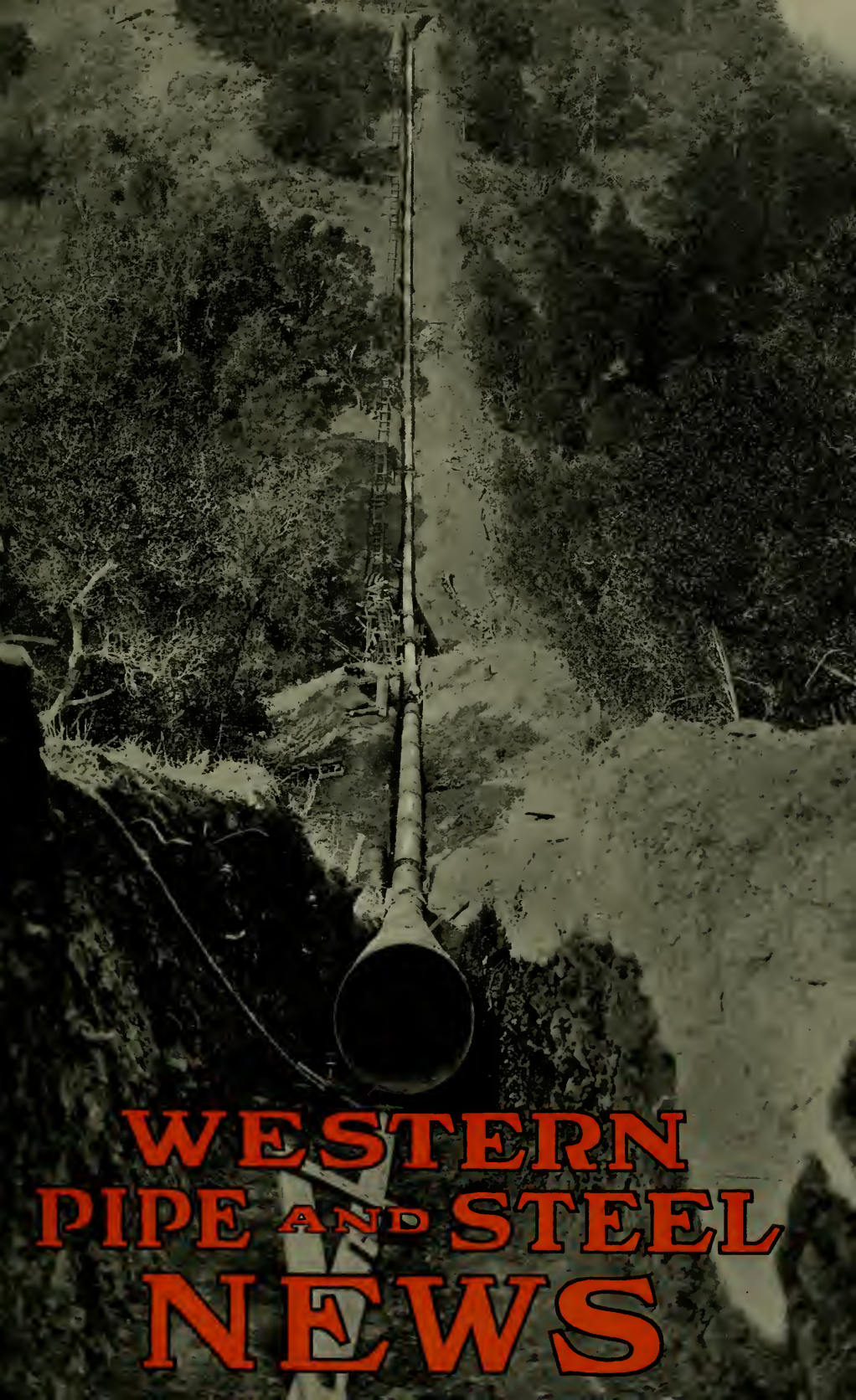
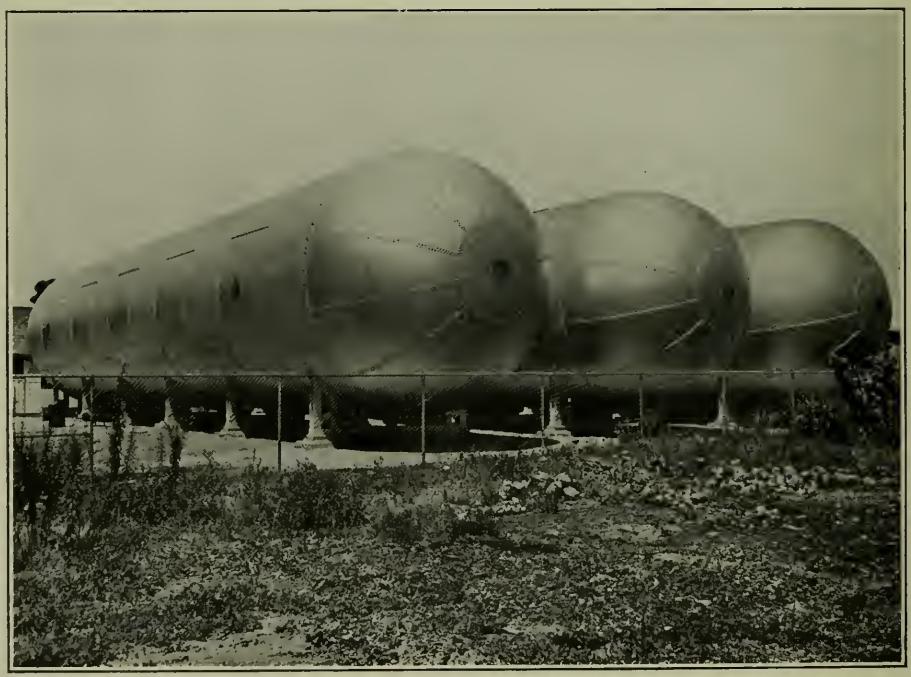


WESTERN PIPE AND STEEL NEWS



HIGH PRESSURE GAS HOLDERS FABRICATED AND ERECTED BY W. P. & S. FOR SOUTHERN COUNTIES GAS CO.—*The two above are located at Sierra Madre, and their capacity is 104,800 cubic feet each. The three below are at Orange. Total capacity, 230,000 cubic feet.*

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SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME III DECEMBER, 1926 NUMBER 10

A Brief Review of "Western" Activities During the Year 1926

By the EDITOR

CONSIDERED from the standpoint of general expansion of plant facilities, additions to shop equipment, and a general broadening of manufacturing scope, through which several new products have been added to our standard lines, the year 1926 must be put down as one of the most important and constructive in the history of Western Pipe & Steel Co. of California.

It was also an important year in the matter of volume of business done, and of projects of considerable magnitude carried to completion during the year or undertaken. The purpose of this review will be to touch briefly upon the high points of the year, and to emphasize the things that we have done and are equipped to do, all of which we feel will make our customers, both regular and potential, a little more familiar with our facilities.

AT LOS ANGELES

The shop expansion carried out at Los Angeles in 1926 included the development of a full fledged structural steel department, providing facilities for the fabrication on an extensive scale of structural material in any quantity and for all purposes including buildings, bridges, etc. A large number of structural steel contracts were executed during the year.

Another department brought actively to the front at our Los Angeles plant was that specializing in pressed steel products, which we are now equipped to manufacture on an extensive scale. Products include pressed steel car parts, including sills and braces; man-hole plates, boiler heads, pressure tank heads, dished heads, cover plates, steel flanges, etc.

HIGH PRESSURE GAS HOLDERS

One of the outstanding contracts completed during the year was the fabrication and erection of twelve high-pressure gas holders at various points in Southern California for the Southern Counties Gas Co. These holders, of horizontal cylindrical type, represented a new departure in gas storage design and the selection of Western Pipe & Steel Co. to execute work along lines entirely new and original was extremely gratifying to us.

NEW SOUTH SAN FRANCISCO SHOP

The early part of the year saw the completion of our new heavy plate and pipe shop at South San Francisco. Planned primarily to house an entirely new department—Lock-Bar steel pipe—the addition of this unit, 1240 feet long by 80 feet wide, makes our South San Francisco plant one of the largest industrial establishments of its kind in the West. Approximately one-half of the area of

the new bay is occupied by the Lock-Bar department. The balance is devoted to heavy plate fabrication of various kinds. A great deal of new shop equipment has been installed in the last year, not only at South San Francisco, but also at Los Angeles, and our other factories.

STEEL PIPE LINES

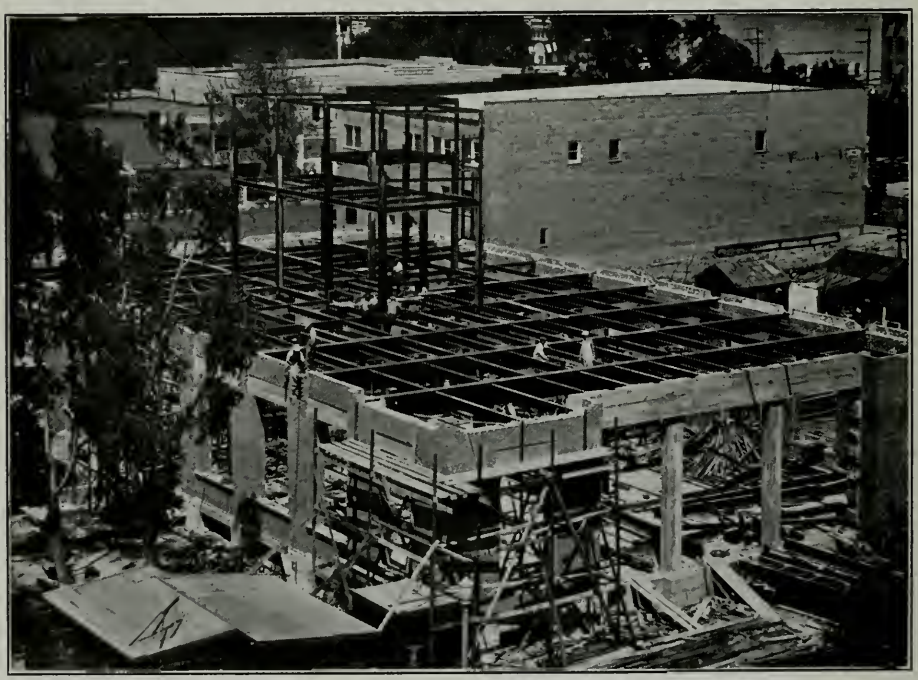
A number of notable pipe line projects were completed during the year, and others now under way are to be completed later. Among those finished may be mentioned the twenty-two mile welded steel pipe line for the City of Vallejo; the Marin Municipal Water District's new welded transmission line consisting of 37,400 feet of 26-inch and 30-inch welded steel pipe, which we believe to be the crookedest pipe line ever installed, approximately 85 per cent of the joints being elbows; the Devil's Canyon project of the City of San Bernardino, and numerous other pipe line installations at various Pacific Coast points.

LOCK-BAR STEEL PIPE

The year witnessed the beginning of two notable Lock-Bar steel pipe projects—one for the City of San Diego, consisting of some seventeen miles of 36-inch pipe, having a carrying capacity of 10,000,000 gallons daily, to bring water to the City's University Heights reservoir from Riverview pumping station (later from a reservoir to be completed with the erection of El Capitan dam). The other Lock-Bar project calls for some 2800 tons of Lock-Bar pipe 46-inch to 56-inch in diameter, for the Fairbanks Exploration Co., in Alaska. This pipe was transported to Alaska by steamship, three vessels being required to handle it.

IN CONCLUSION

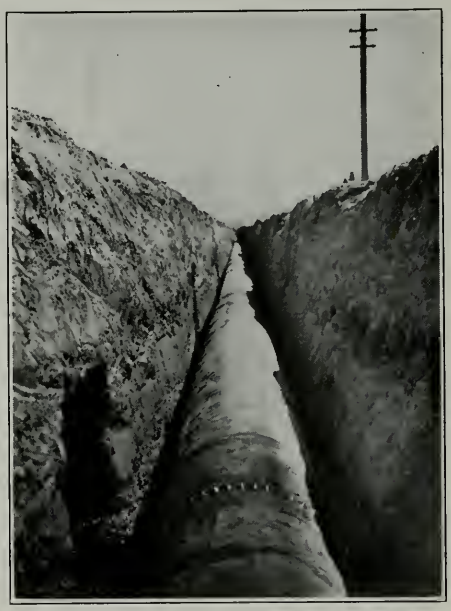
It is impossible to attempt a complete outline of the year's activities of all five of our factories, but the foregoing will give a fair idea of our major



W. P. & S. fabricates structural steel for all purposes. The building illustrated is that of the Bakersfield Californian.

activities during 1926. Necessarily much of the major work is done at the two large plants at Los Angeles and South San Francisco. The other three factories, however, have more than contributed their quota to the year's volume. The factory at Fresno, which takes care of the needs of the San Joaquin Valley, was enlarged early in the year to keep pace with the demands of that populous region. The Phoenix plant showed one of the best years in its history, while at Taft, in the center of the Midway oil fields, the manufacturing resources of our factory were more than once taxed to the utmost capacity to supply the demand there.

THE COVER PICTURE.—Some months ago we devoted an issue to the Marin Municipal Water District's new welded steel pipe line. The syphon, shown on the cover of this issue, was not completed at that time. It is printed here to complete the illustration of this project.



Installation of Lock-Bar steel pipe for the City of San Diego.

View of installation of steel storage tanks for Bass-Heuter Paint Co., San Francisco. Fabricated by W. P. & S. Co.

LOS ANGELES PLANT OF WESTERN PIPE & STEEL COMPANY OF CALIFORNI

plant. The frontage is 630 feet, depth 1215 feet, and the total land area embraced in the site is
and most up-to-date manufacturing establishments in the country devoted to the fabrication of
poses, oil well and water well casing, oil refinery equipment, steel pipe, structural steel, pressed

ting view, taken from the Santa Fe Avenue front, shows the magnitude of our Los Angeles -half acres. This factory, one of five operated by the company, is one of the best equipped l. The principal products of the Los Angeles plant include steel storage tanks for all pur- oilers, metal culverts, galvanized products, etc.

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THIS issue of *Western Pipe & Steel News* marks the close of the year 1926 and of volume three of this magazine. In both text and illustrations, we indulge in the ancient prerogative of editors, to review the year.

This review has been made brief and to the point. Throughout the year it has been our effort to present to our readers timely and interesting information, appropriately illustrated, regarding our various activities.

Having had the privilege of acting as the medium for the transmission of such information, the editor feels that he should here record his appreciation of the continued favor with which *Western Pipe & Steel News* is apparently received.

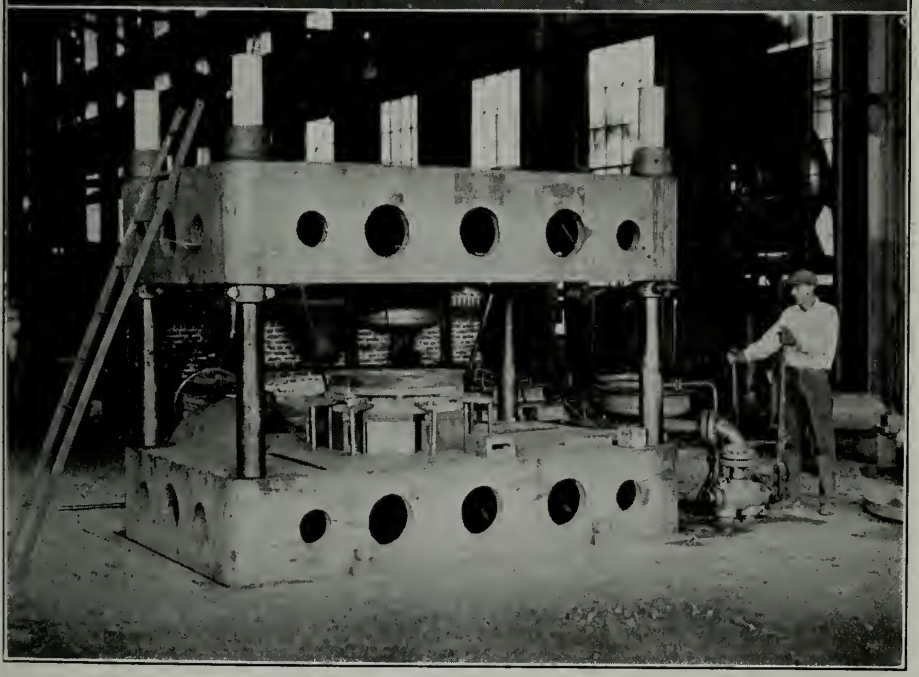
Starting a little less than three years ago with a circulation of not quite two thousand copies, the magazine has grown until today we are printing four thousand copies of each issue. We take this as a good sign. We hope that it justifies the statement made in the first issue, from which we quote:

"We propose to do two things in this publication: to broadcast helpful information, and to talk about Western Pipe & Steel.

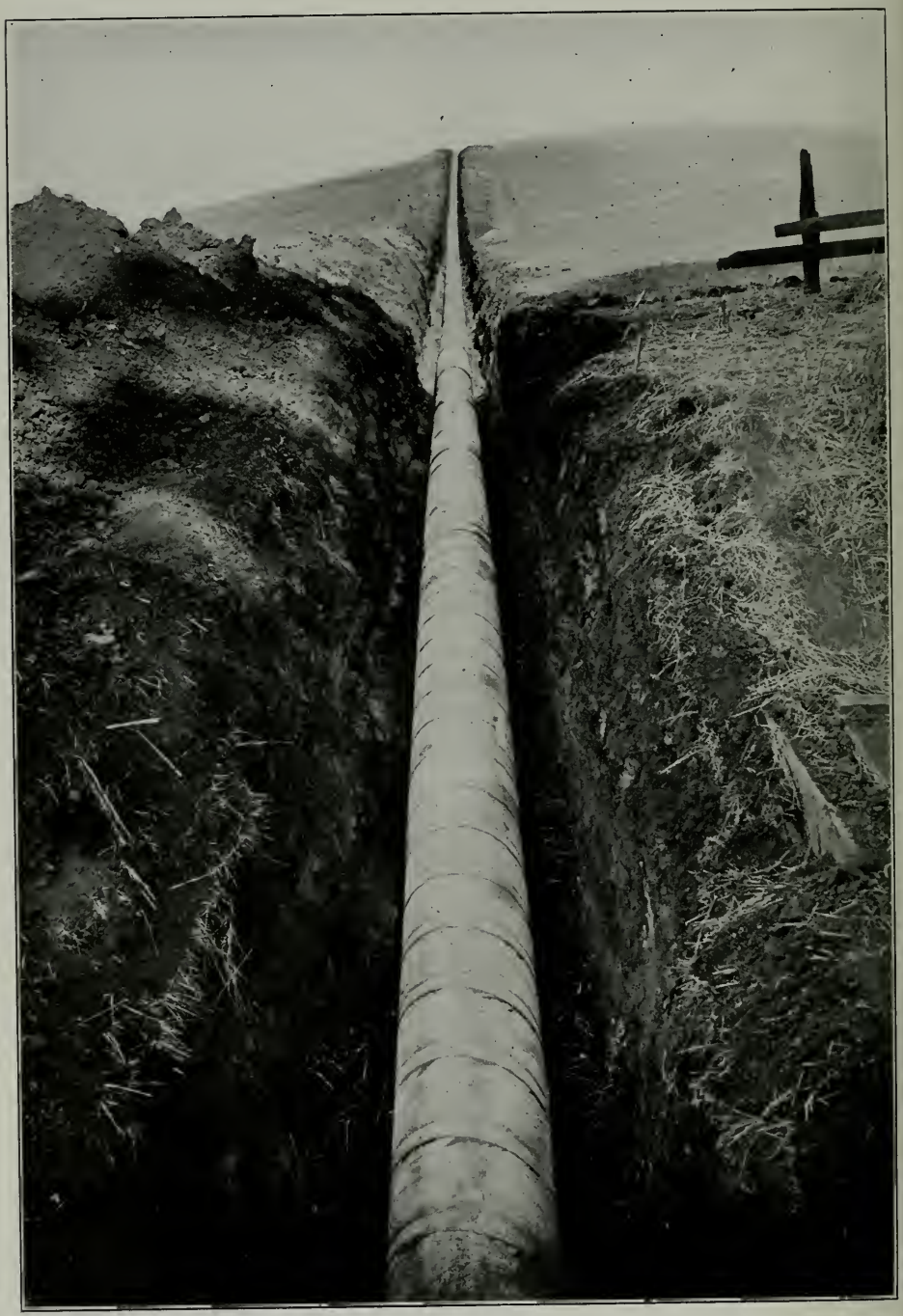
"It pays to advertise, provided nothing is claimed that cannot be proved, and the quality of the product measures up to the words that are used to describe it.

"We believe there is a going value in good will. We try to deserve good will by proper business methods in the office, responsible representation in the field, and first-class workmanship in the plant. We have a single standard that controls all our relations—with our employees, with our customers, and with our competitors. That standard impels us to give a square deal and to exact no less."

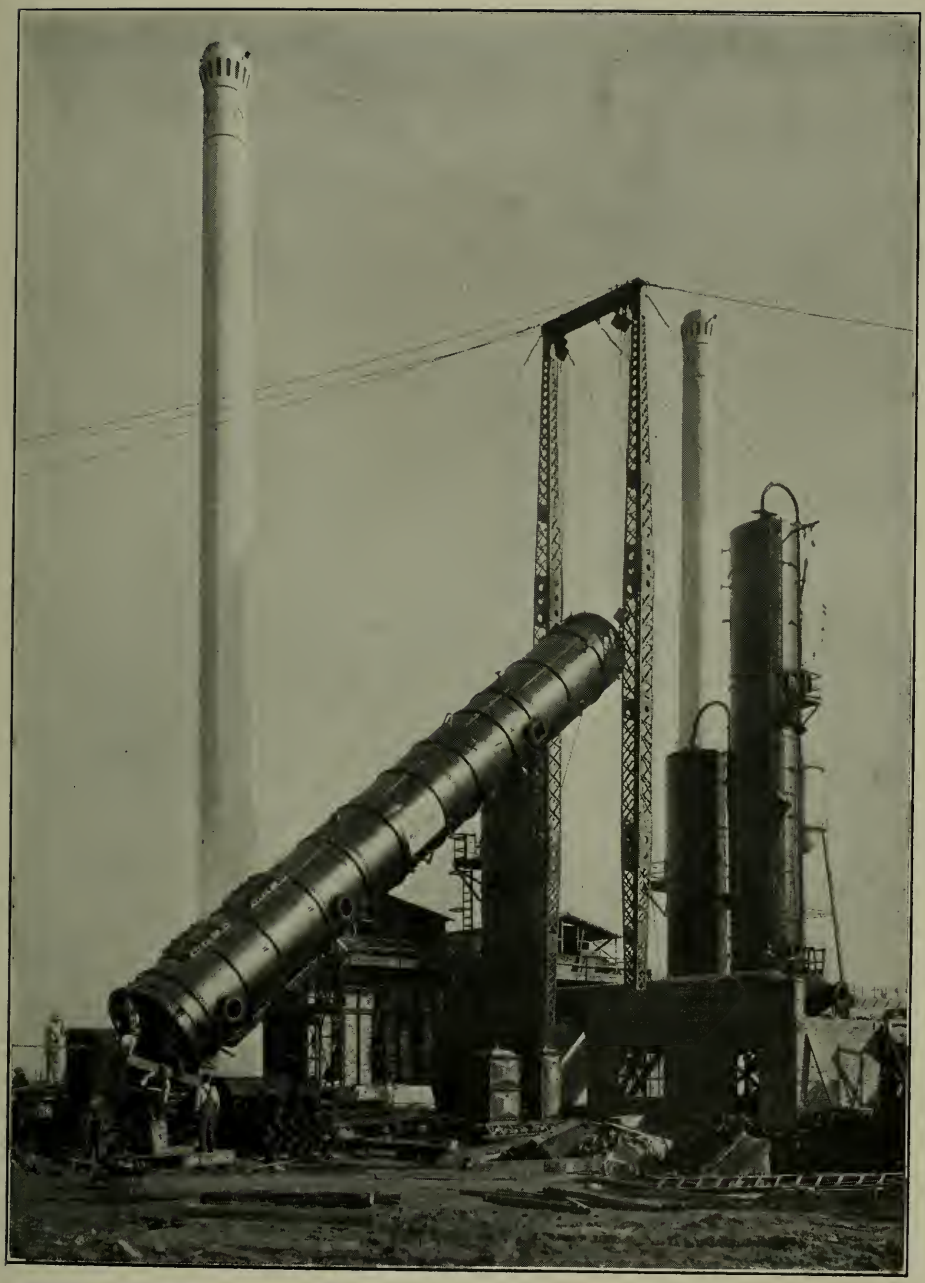
A portion of the new Lock-Bar steel pipe department, South San Francisco plant. This new building was completed early in the year.



These two views show our pressed steel department at Los Angeles. Products include car parts, flanged and dished heads, etc.



Along the line of the twenty-two mile welded and soil-proofed pipe line of the City of Vallejo, one of the major pipe projects completed during the year.



ERECTING A KELLOGG DEPHLEGMATOR TOWER MADE AT LOS ANGELES FOR RICHFIELD OIL CO.—*Manufacturing both standard and special equipment for the oil industry has long been a W. P. & S. specialty. The dephlegmator tower pictured above is 75 feet high, 8 feet 7 inches in diameter and weighs 62 tons.*

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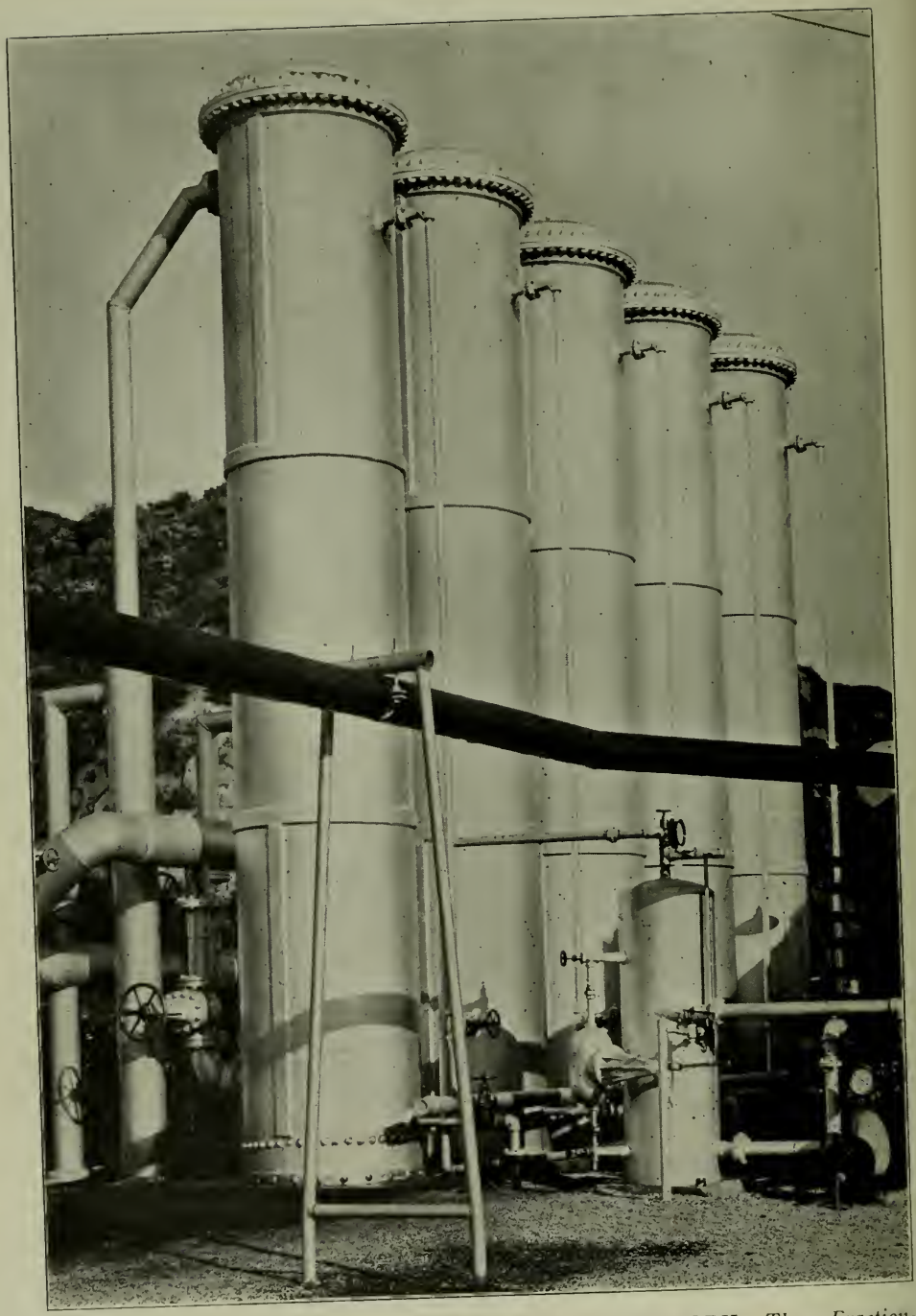

A MOST UNUSUAL EXAMPLE OF HEAVY WELDED WORK.—*These Fractionating Towers, made by W. P. & S. at Los Angeles for Cienaga Corporation and installed at Fillmore, Cal., are of 1" steel plate, electric butt welded with outside butt straps. Working pressure 400 lbs. per square inch. (Hydrostatic tests 600 lbs. per square inch). They are 46" diameter inside and 24' high.*

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VOLUME IV JANUARY, 1927 NUMBER 1

Fabrication of Iron and Steel by the Electric Arc Process

By R. W. BEARD, General Electric Co.

DURING the past few years the use of electric arc welding as a manufacturing process has rapidly expanded. The versatility of the process, supported by the research of engineering societies and large manufacturers of equipment and steel products, has established the process and the welded product on a sound basis. In this development the West has taken an active part and has contributed much to the advancement of the art.

Electric arc welding was practiced for many years as a little known art. It received its first great impetus during the time of the World War when, in the stress of the times, men looked for the fastest and most efficient way of fabricating new materials and salvaging old. Since then more and more applications have been found and today we find it standard practice in the fabrication of water pipe lines, low pressure steam lines, tanks and a multitude of other steel products. In the pressure vessel and structural fields it has also gained a firm foot-hold, and under the present research program of the American Welding Bureau will progress much farther.

The process in itself is simple. Metal surfaces to be joined are placed in their proper relative positions and fused together by an electric arc. The arc is usually drawn between the plates to be welded and a metal electrode, the end of which also fuses, supplying the necessary additional metal for the seam.

A great deal of study has been given to these electrodes or filler rods, as their composition largely determines the strength and ductibility of the weld. The arc may be maintained by an operator holding the electrode in the proper position relative to the seam or it may be maintained automatically by special machines which not only maintain the proper length of arc but also move the electrode along the seam at a proper rate to make a smooth, continuous weld. Current for either method is usually supplied by a direct current generator of special design to give proper arc conditions.

In modern manufacture both the hand and the automatic processes are used. In general it may be said that the automatic process is confined to standard types of articles in which there is considerable duplication. This permits arrangements of suitable jigs and equipment. Quantity production of high quality welds are obtained by the process. Hand welding is in its nature very versatile, and is used in all general welding of miscellaneous tanks, special fittings, frames, boxes and in repair work.

On the Pacific Coast we find many large plants fabricating welded products. Among these are tank manufacturers, pipe manufacturers, steel companies, foundries and many others. At the plants of the Western Pipe & Steel Company will be found some of the most complete equipment in the West

fabricating pipe, tanks and many other steel products. Their automatic equipments for welding of steel pipe are of particular interest and are typical of this kind of equipment.

These full automatic equipments for welding longitudinal seams, each consist of complete clamping device for holding the pipe during the welding process, automatic welding head, and travel carriage for moving the electrode and arc along the seam. The pipe is placed on a supporting arm and then clamped firmly in position by air pressure. The welding head is then moved to its starting position at one end of the pipe directly in line with the seam. The operator then pushes a button and the electrode starts to feed automatically. It moves quickly down to the work, strikes the arc and is rapidly withdrawn to the proper arc length and the travel carriage moves it along the seam. As it progresses it fuses the two edges together and adds the necessary filler, from a continuous reel of electrode, which is fed through the machine. The seam completed, it is returned to the starting position ready for the next pipe. On inspection the completed pipe shows a uniform and unbroken seam capable of withstanding shock and pressure. The pipe is then tested and is ready for soil-proofing or weatherproofing, if required, or for shipment.

The success of these welded pipes has been substantiated in the recently completed pipe line supplying the City of Vallejo. This was an all welded pipe line some 22 miles long 24″ in diameter. Every section was tested in the shop and on completion in the field. During the field tests not one longitudinal seam showed a leak. Nineteen girth seams showed leaks or sweats, out of a total of 8200 circumferential seams. It is interesting to

This picture illustrates what is known as a rope weld, and shows the bottom construction of a dephlegmator tower. The rope weld has many uses, of which this is typical.

note that in this project Western engineering and manufacturing took the lead, this being the longest and first all-welded pipe line in this country.

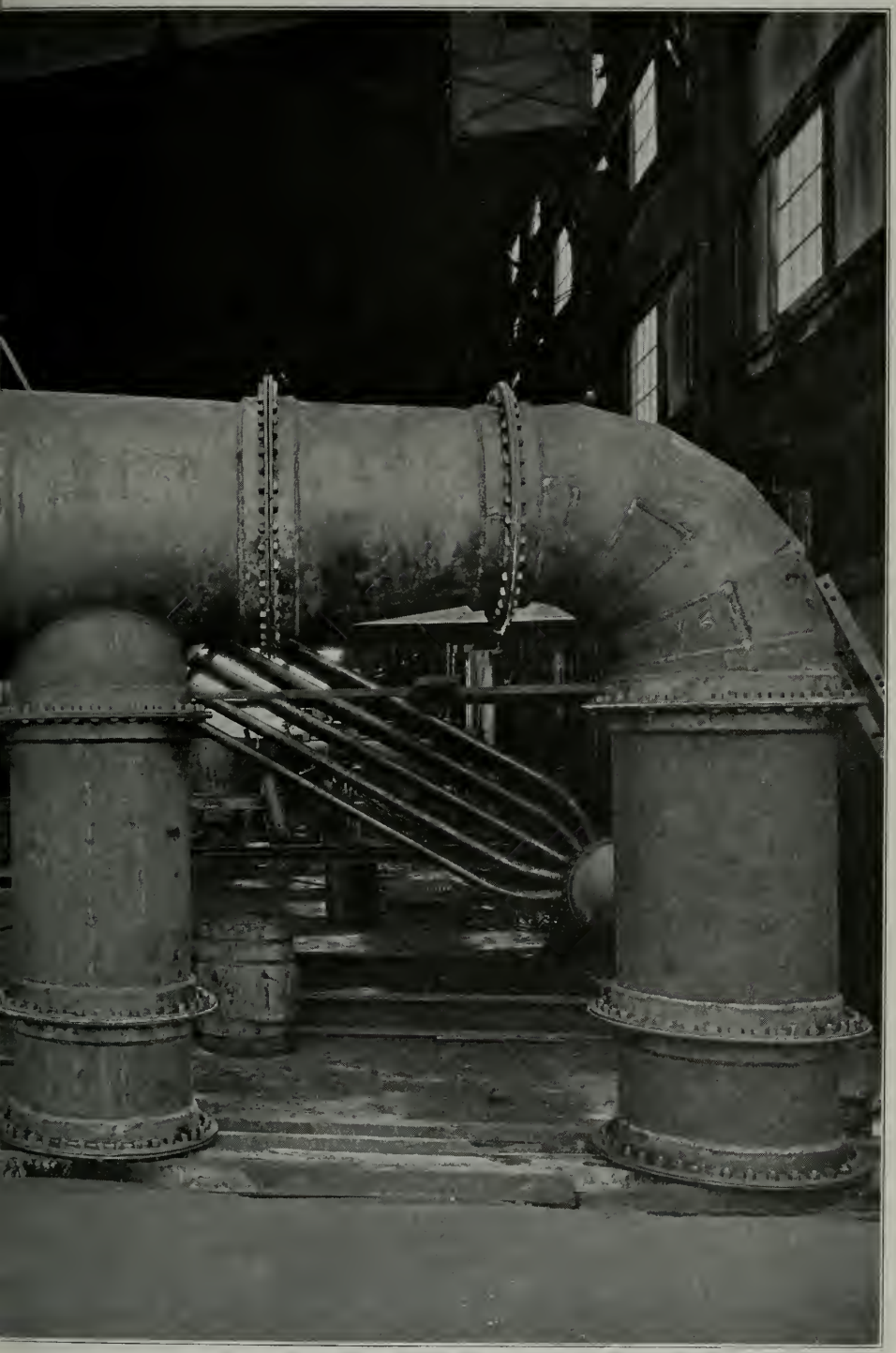
The question may be asked "What of the future of electric welding?" Today it finds innumerable applications but it is still in its infancy. Progressive manufacturers are continually studying methods and finding new application; equipment manufacturers are constantly improving their welding equipments and methods, and electrode manufacturers are developing electrodes more suitable for each metal and alloy. Notable among these studies are those on atomic hydrogen welding and welding in a gaseous atmosphere being conducted by the General Electric Company. Various engineering societies are also appointing committees with the idea of developing a more equitable code of welding.

Along the line of future development the proposed program of the American Welding Bureau is of interest. They plan an investigation of structural steel welding and of pressure vessels. This last will include tests to destruction, fatigue tests and breathing tests. In addition to this, fundamental investigations on such subjects as effects of high temperatures on welds, tests of welds, forging of welds, etc., are contemplated. Studies of effects of temperature on the weld metal are being made by the San Francisco Section of the American Welding Society.

Many other programs of study are being conducted. Yesterday our colleges taught only riveting theory. Today we find welding in many of their curricula. This wide program of development and education, abetted by the progressive manufacturer and the open-minded user, means a rapid development of an art which is already firmly established in the metal industry, throughout the world.

A welded specialty made at Los Angeles. This "exchanger" is 14'x42"x3/16" shell, made for California Gasoline Co.

AN UNUSUAL EXAMPLE OF SPECIAL WELDED WORK, FABRICATED AT W. I
the American Potash & Chemical Co., Trona, Calif. The manifold has been temporarily asse
high. It is made of ⅜" steel plate. There is far more welding work on this manifold than is



NGELES PLANT.—*This illustration shows one of four vapor manifolds for heaters, made for op for testing. This unusual piece of work measures about 27′ over all, and stands about 12′ glance. Special attention is directed to the welding details of the two elbows.*

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THIS number of Western Pipe & Steel News, as may be gathered from the illustration of an automatic electric arc welding machine on the front cover, is devoted to welded processes and products. The picture was taken at our Los Angeles plant when the night shift was rushing a pipe order to completion, and shows automatic welding of straight seam on steel pipe 20″ in diameter, ¼″ plate.

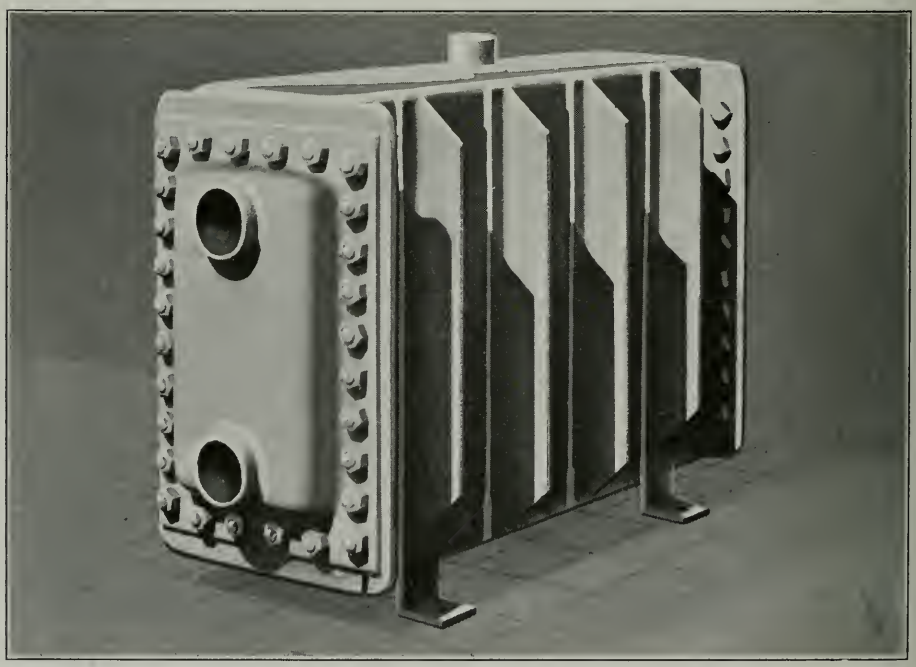
The operation of this machine is described in detail in the leading article, which was specially written for this issue by R. W. Beard, welding specialist of the General Electric Company.

We call particular attention to Mr. Beard's article because it embodies not only an interesting review of the progress made in the last few years, but also tells of the intensive research and experiment going forward in various quarters, which may be expected to add materially to the knowledge of welding.

Needless to say, Western Pipe & Steel Co. has always been intensely interested in welded work, not only in such products as steel pipe for water, gas, etc., steel tanks for various purposes, but also in welded specialties, some of which are illustrated herein. Our own engineers have developed some important applications of welding, as, for instance, a method of replacing old bottoms in large oil storage tanks, thereby doing away with the necessity for raising the tank or disturbing the roof.

We also fabricated the first oil storage tanks erected in California with electrically welded bottoms.

Because welding is oftimes more economical and more practical than other types of construction, we proffer the services of our engineering department for consultation on this subject.



We manufacture these heat exchangers for oil refineries at our Los Angeles plant. The work is all welded except the bolted heads.

"Made In California"

By Aaron F. Norton, President, Federal Water Heater Co.

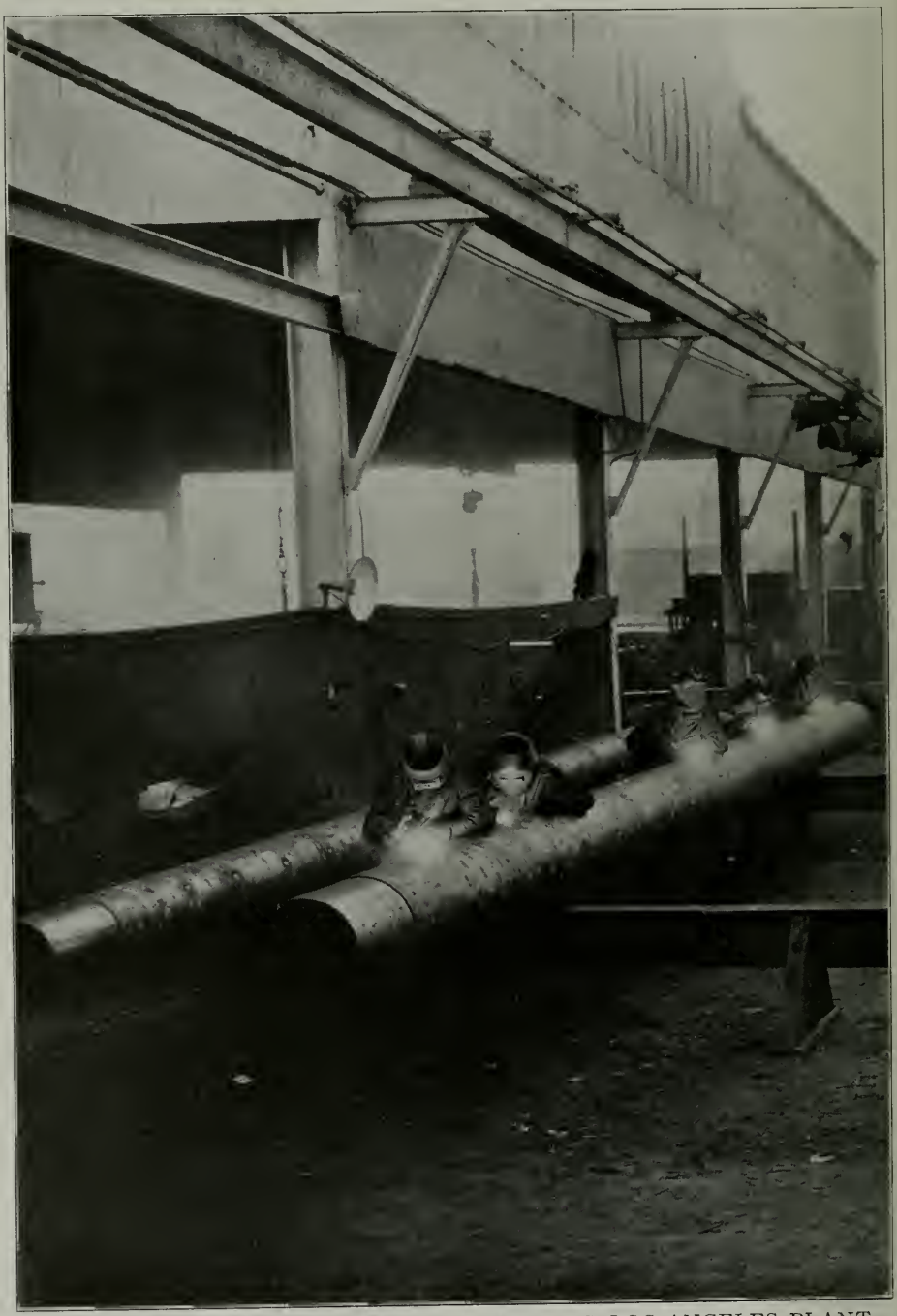
It is an obvious fact that it is more economical to transport raw materials than manufactured products. But for a long time California was slow to translate this fact into local manufacture. We instance household water heaters from the long list of manufactured products once shipped from the East in large quantities which could and should have been made here.

About ten years ago we started to manufacture in Los Angeles an automatic storage type of household water heater. It had been done before, but had not been commercially successful. With the heater, we developed a foolproof thermostatic valve, positive in its action of turning on and off the gas. The storage tank will hold hot water like a thermos bottle because it is well protected by an efficient insulation. While we pioneered the manufacture of this apparatus, others followed, until now there are about 100 manufacturers in the United States producing it.

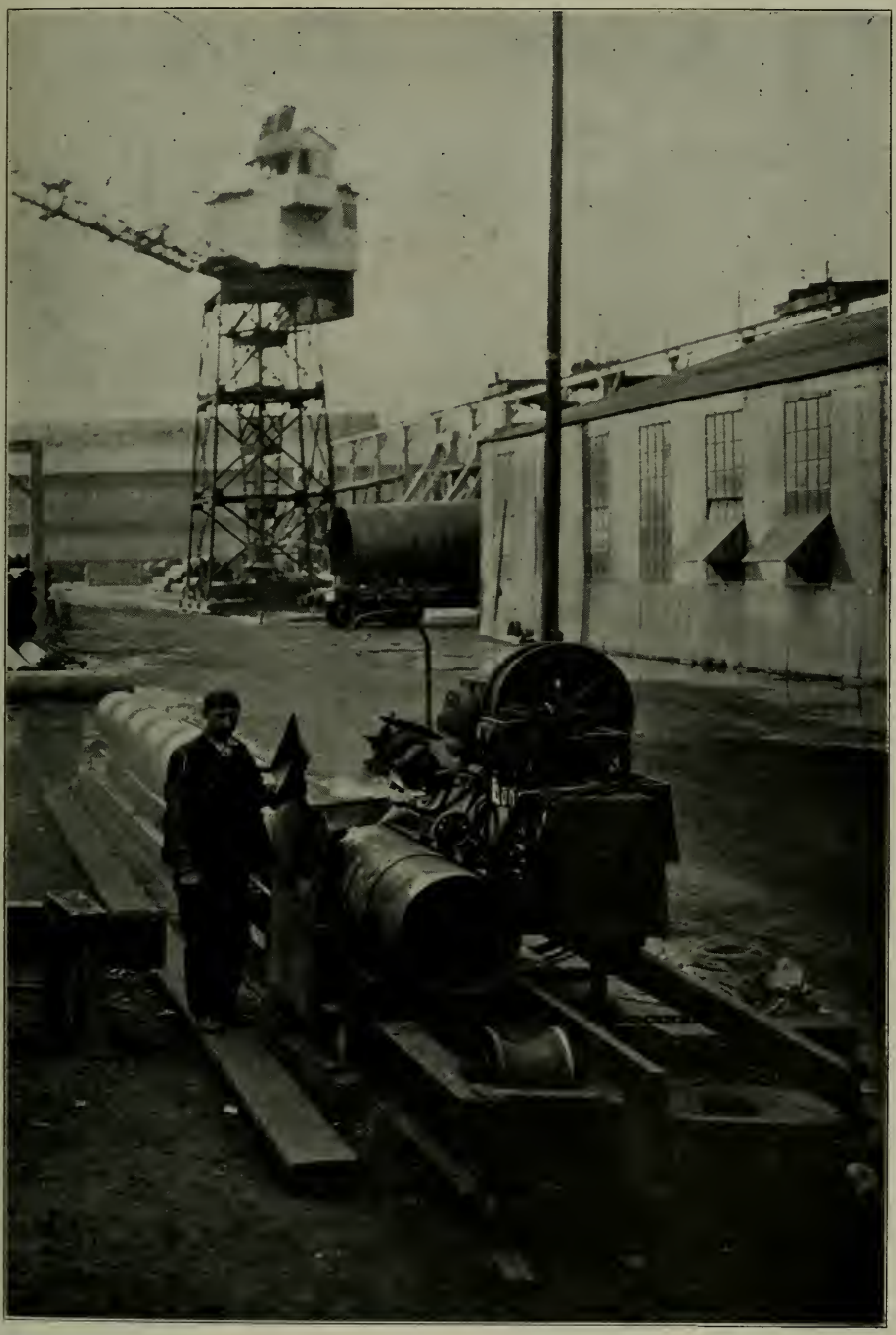
As hot water is drawn from the tap and replaced with cold water by line pressure, the thermostatic valve opens automatically and gas burns until the water reaches a temperature of 145 degrees, when the valve automatically closes.

Western Pipe & Steel Co. manufactures all our boilers which are made of 12-gauge blue annealed steel, heavily galvanized inside and out, and tested to 150 lbs. pressure. These boilers are 12"x48", capacity 19¼ gallons. We also make larger boilers to care for the requirements of any size residence or apartment house.

Another example of special welded work. Part of an order of 1700 water heaters 12"x48", manufactured for the Federal Water Heater Co. at Los Angeles.



SPOT WELDING OIL WELL CASING AT W. P. & S. LOS ANGELES PLANT.—*Welding, one type of which is shown above, is an important factor in the construction of "Western" stove pipe casing, made of special hard red steel. This casing is water-tight and air-tight, and due to rugged construction is exceptionally strong, withstanding a pressure of 600 pounds.*



AUTOMATIC WELDING OF ROUND SEAMS ON OIL WELL CASING.—*This picture, taken at our Los Angeles plant, shows one step in the fabrication of oil well casing. Spot welding is illustrated on the opposite page. The two pictures are in reality one as the casing moves from this machine along the skids to the spot welding crew.*

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NEWS

STRUCTURAL STEEL FOR THE NEW BUILDING OF THE BAKERSFIELD CALIFORNIAN WAS FABRICATED AT OUR LOS ANGELES PLANT.—*Upper view shows the building as a whole, while below is a detail view of the steel work.*

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VOLUME IV FEBRUARY, 1927 NUMBER 2

The Romance of Steel

By W. W. BREITE, C. E.

THE steel industry in the United States dates from the year 1786. It was in that year that the legislature of Pennsylvania voted to loan a Mr. Humphreys $1,500, for a period of five years, to enable him to continue his attempts to make bar iron into steel "as good as in England." By 1810 the total production in the United States was scarcely more than 900 tons per annum, Pennsylvania producing 531 tons or more than one-half of the entire production. By 1830, the manufacture of steel had reached a total production of 1,600 tons per annum, but as this amount was equal to the amount imported, those who were interested in the growth of the home industry felt that American producers would do very well if they were able to continue to divide the market with the foreigners.

The period between 1831 and 1860 saw little progress in the development of the steel industry in America; in 1850 the total production of the country was scarcely 6,000 tons.

The first crucible steel produced as a regular product from American iron was made by Hussey, Wells & Co., in 1850, and they remained the largest manufacturers until 1862, when Park Brothers & Co. established their big steel plant and imported several hundred English workmen to teach American labor the best and cheapest methods of producing steel. All these concerns were located in Pittsburgh. It was not until 1864 that the Iron Age began to give way to the new King, Steel.

The first notable improvement was the production of Bessemer steel, a method which was first adopted in 1864. With this invention steel could be produced so much cheaper as to warrant its adaptation to a great many uses undreamed of before then.

Up to 1895 the Bessemer process reigned supreme; it was then not considered likely that this method was to be supplemented by an invention which would not only improve but materially reduce the cost of production. With the invention of the basic process, it was at last possible to make use of impure ores in the Bessemer converter, and the older system had a worthy rival.

The first experiments with the open-hearth furnace were made in England, and were watched with considerable interest by representatives of the American manufacturers. When the Thomas basic process was announced and it was found to be well adapted to the open-hearth furnace, Cooper, Hewitt & Co. began to experiment with it in the United States. In the beginning, of course, the establishment of the open-hearth system entailed great expense, but while, at first, this necessitated its restriction to few uses, it was not long before the necessary improvements were made and the cost was so materially reduced that the new method was placed in a position that made it possible to compete with the Bessemer process. In fact, it was the introduction of the open-hearth method that enabled the South to take an important position in the manufacture of steel,

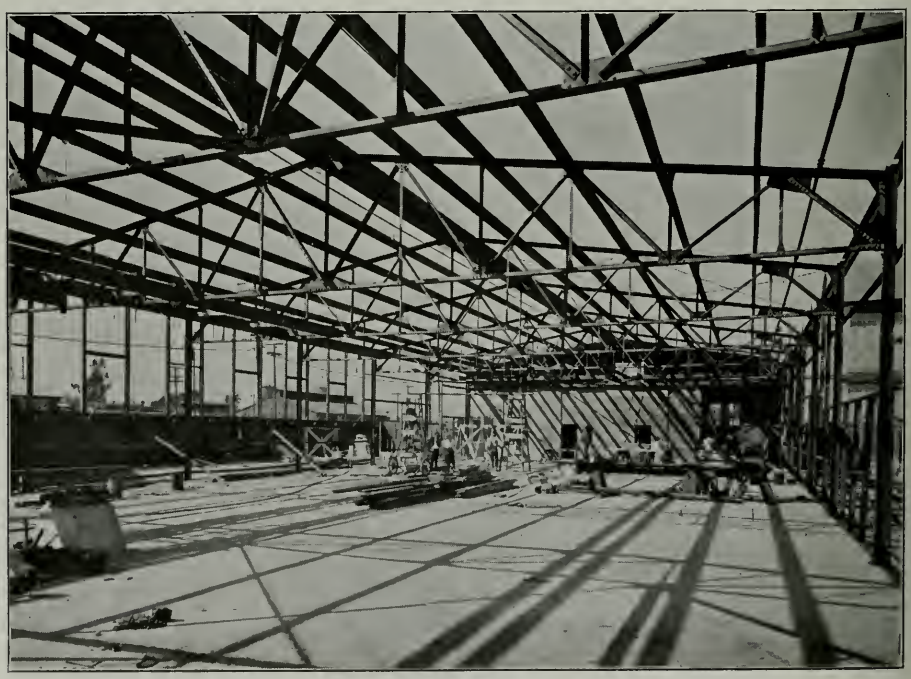
so we might really say that the steel age did not actually begin in America until the introduction and development of this process.

When we stop to think and realize that this is very little more than three decades ago, we cannot but marvel at the wonderful strides made in the industry in this short period; of the many countless articles in the manufacture of which steel is a component part; in fact, it is almost impossible to conceive of being able to carry on the ordinary pursuits of life if our steel supply were to be cut off. If the demands continue to increase in number with anything like the frequency that has been shown in the last 30 years, the question of supply may not improbably become a matter of considerable importance.

Probably the greatest advancement made in the steel industry, and the one that has undoubtedly benefited the human race more than any other development, has been in the improvement made along structural lines. Without this development the entire character of all of our cities would be changed.

It has changed the sky line throughout the country and has made possible the erection of hundreds of thousands of buildings of from 10 to 20 and many of from 30 to 40 stories in height; it has increased the property values of the land throughout the country by reason of the fact more people are today accommodated per square foot of ground area than ever before. Many of the large structures throughout the country have a greater population than hundreds of the smaller cities and towns throughout the world, and the problem of traffic in the congested areas of the larger cities has become a serious one, especially during the morning, noon and evening hours when the tenants come to or go from work and to lunch.

It has made possible the spanning of thousands of streams by bridges of length, design and construction not even dreamed of 25 years ago. It has



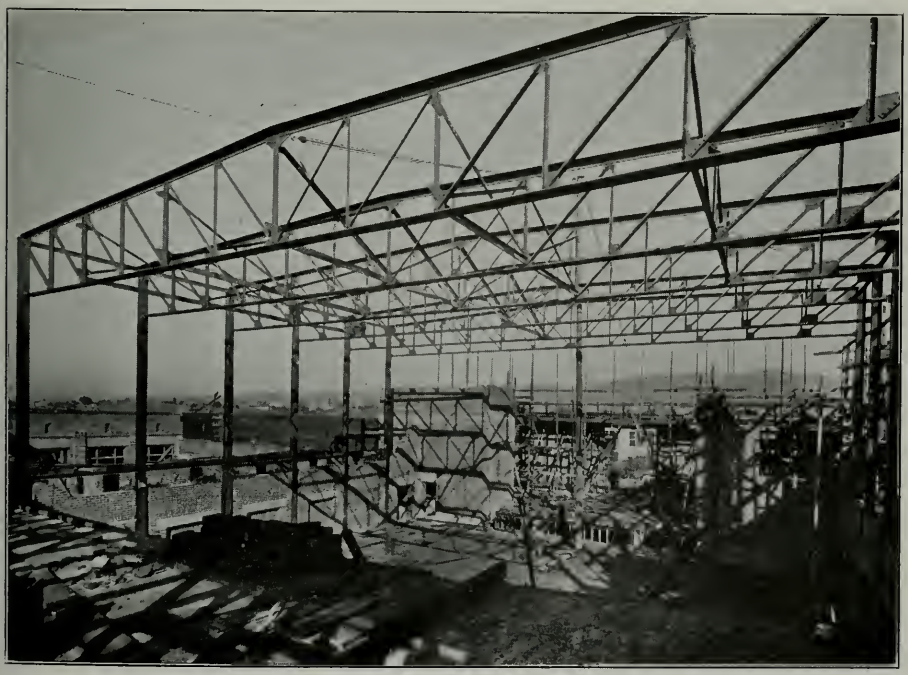
Our Los Angeles plant fabricated steel for this building for the McEvoy Well Strainer Co., located on Slauson Avenue.

developed a new type of architecture, typically American in character and utilitarian in purpose. In fact when we examine the records of achievements made possible by the development of this branch of the steel industry, we must admit that it not alone has been of immeasurable benefit to the human race, but that it has also changed entirely living conditions throughout the country.

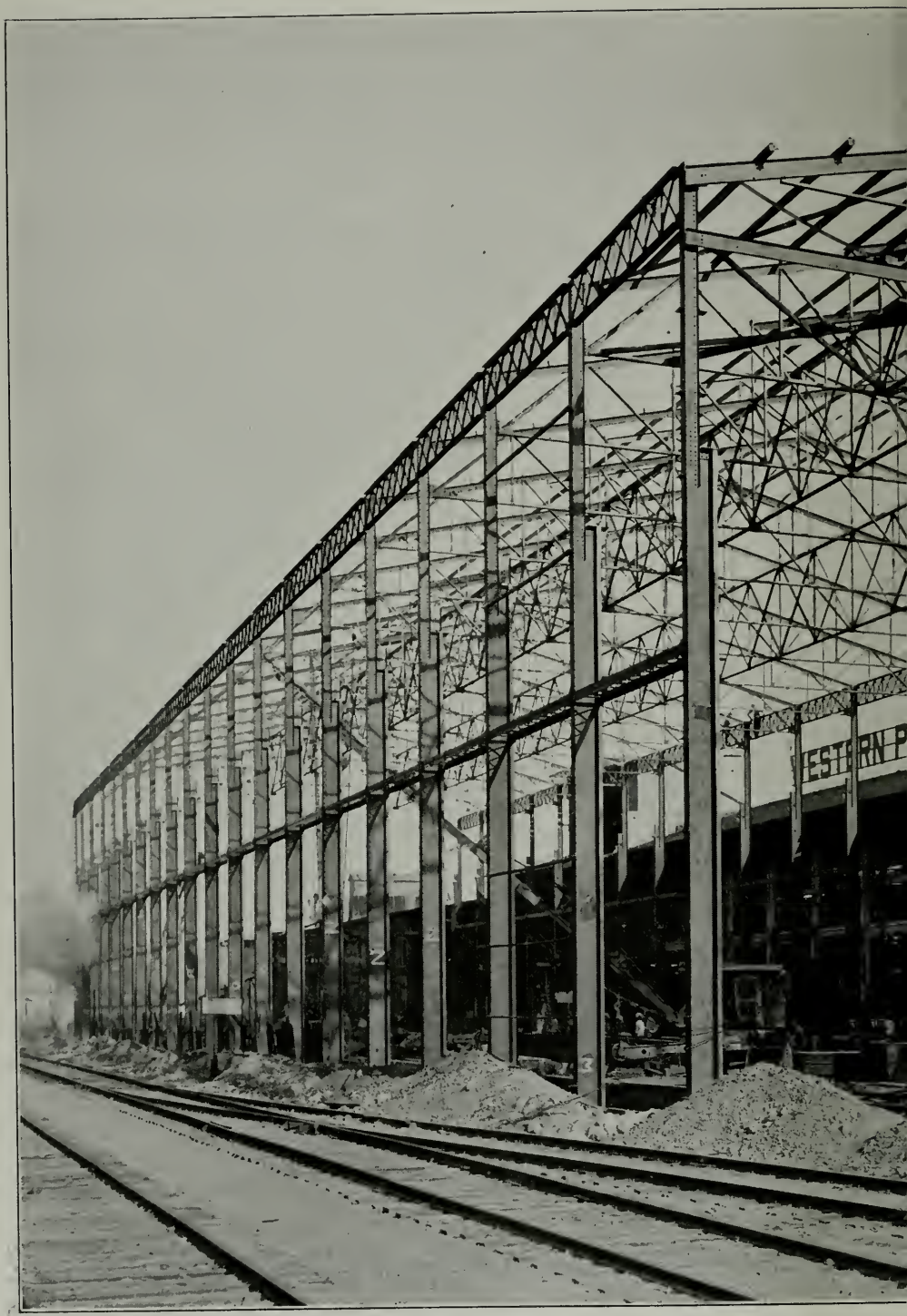
While the center of the steel industry still remains as it ever has been in the state of Pennsylvania, the industry is being developed in many other sections throughout the country. Both in the West and South many large plants are in operation and both of these sections give every indication of becoming great steel centers.

California is fortunately situated in this respect, having within its borders or close thereto, many large deposits of iron and allied minerals used in the manufacture of steel, and with its tremendous resources in the way of hydro-electric power, with the development that will no doubt be made in the electrometallurgical process for the manufacture of steel, it is not unreasonable to assume that some day California will rank as one of the large producing centers of the steel industry of the country.

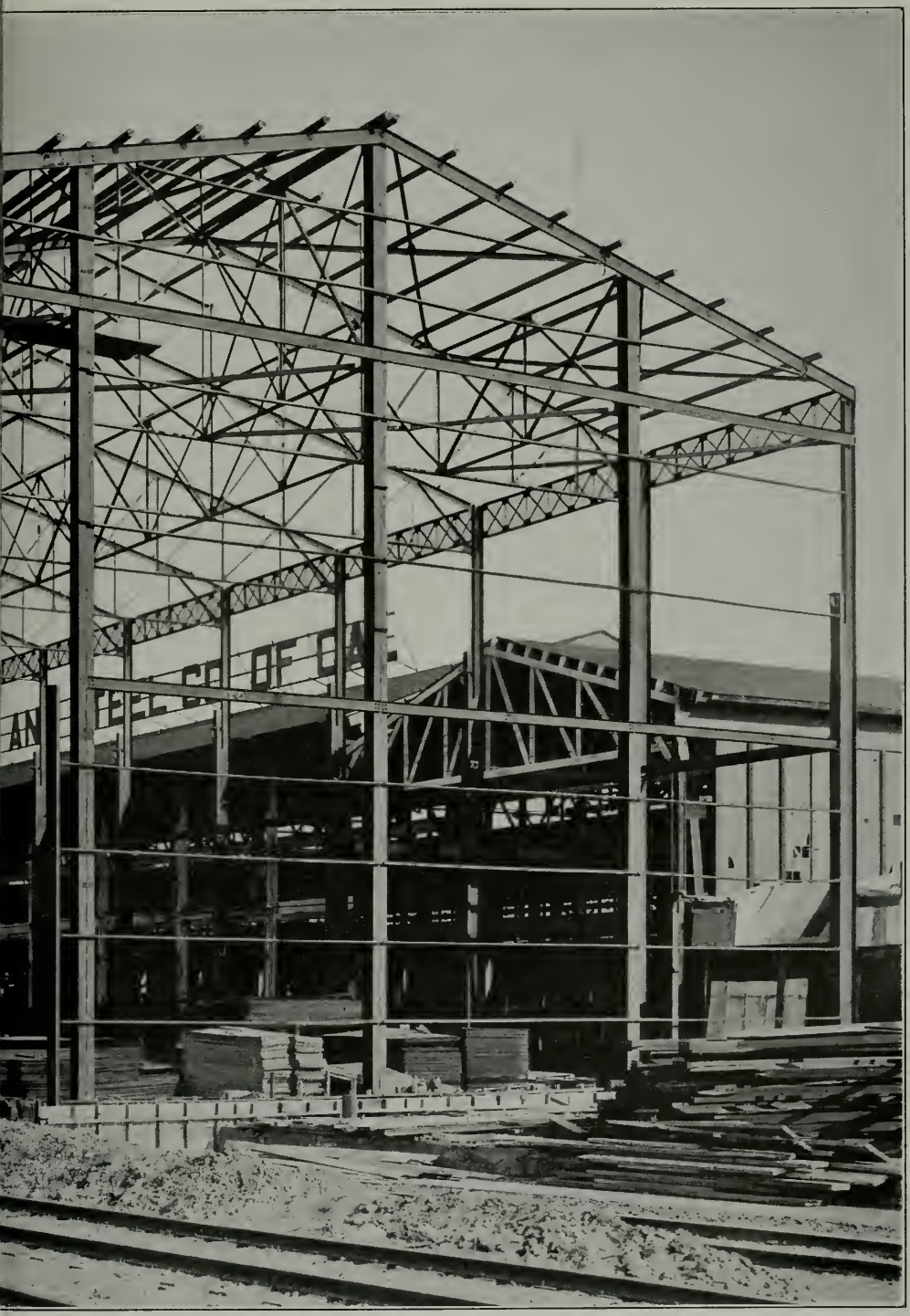
The front cover shows the structural steel work of the new shelter at San Quentin Prison. This material was fabricated at our South San Francisco plant. The present population of San Quentin is about 3,600. The problem of keeping the inmates sheltered in the yard during inclement weather has long been a serious one, the solution of which was finally found in the construction of this huge shed. It will not only serve as a protection from the rain, but will also afford a grateful shade from the hot sun of summer. The pictures of the new San Quentin structure were obtained through the courtesy of Warden Frank J. Smith, under whose direction they were taken by Sid Kepford.



This is the frame of auditorium of Brea-Olinda High School, Brea, California. Structural steel fabricated at Los Angeles.



AN EXAMPLE OF STRUCTURAL STEEL WORK DESIGNED, FABRICATED, AND E
pany's new heavy plate and pipe shop at South San Francisco. It is 1240' long, 80' wide, and the
The tracks in the foreground are the main line of the Southern Pacific railroad. There is a spur t
unloading plates, etc., and lo



TED BY WESTERN PIPE & STEEL CO. OF CALIFORNIA.—*This is the skeleton of the Com-*
ht to the crane rail is 45'. Among other departments, this building houses the Lock-bar pipe shop.
inside the building which traverses its entire length, affording great convenience and economy in
finished products for shipment.

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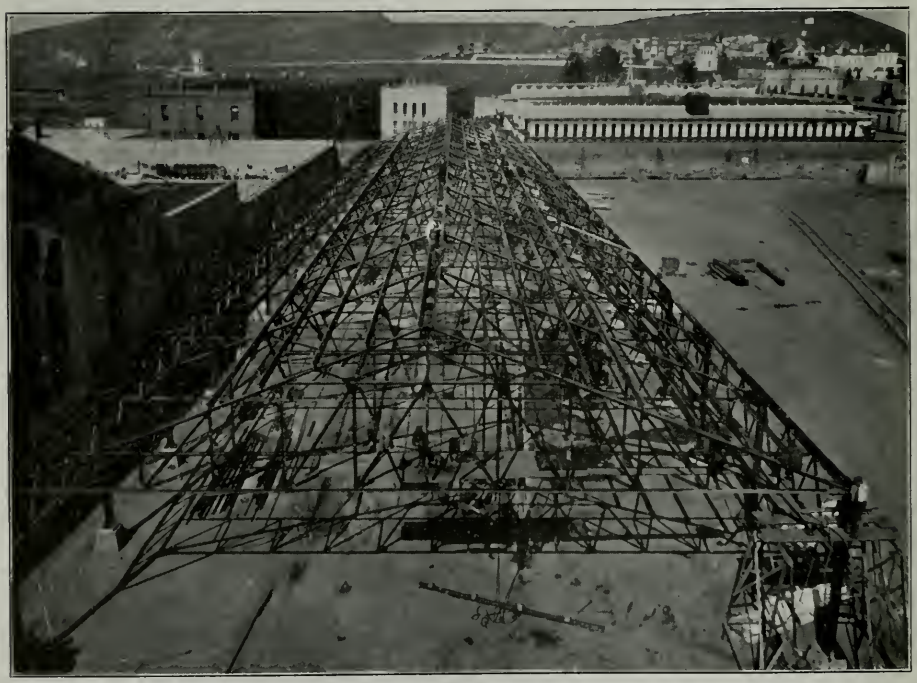
444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY EDWARD F. O'DAY

WESTERN Pipe & Steel Company of California takes pleasure in presenting, in this issue, a series of illustrations of structural steel work. The purpose of these pictures is to convey to our readers that we are factors in the structural field.

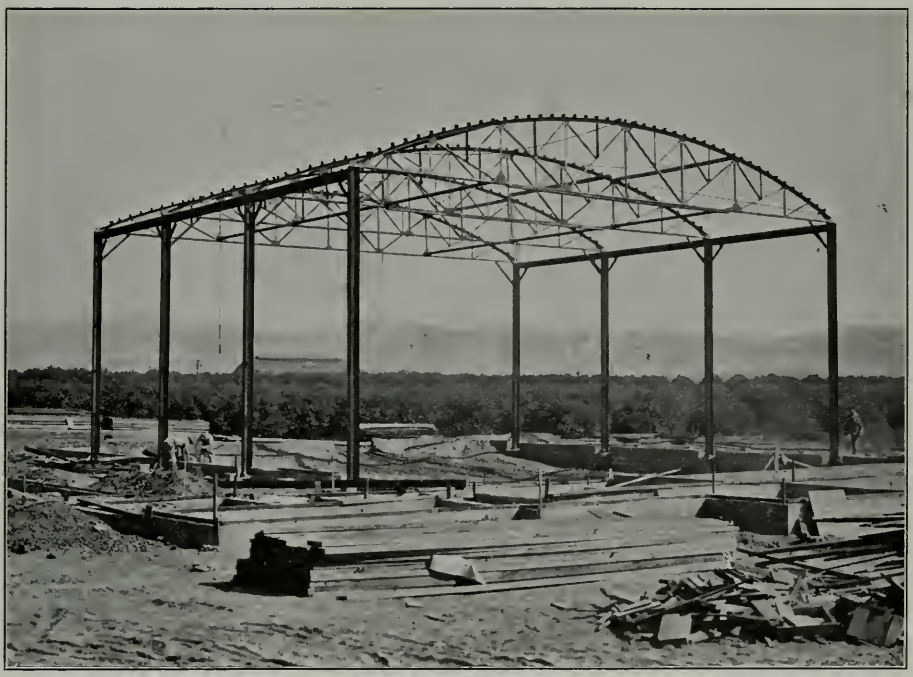
So many engineers, purchasing agents, and others who may be in the market for steel products from time to time, are accustomed to thinking of Western Pipe & Steel Co. in terms of pipe lines, steel storage tanks, galvanized products, corrugated culvert pipe, general plate work, pressed steel products, etc., etc., that doubtless some will be surprised to see to what an extent we have been engaged in fabrication of structural material for buildings.

However, the point that we wish to make in this connection is not how extensively we have engaged in this class of work—although that in itself carries a significant implication of experience—but rather our aim is to stress the point that we are adequately equipped to execute any kind of an order for structural material, be it large or small.

In connection with the fabrication of steel, attention is directed to the leading article in this issue, written by W. W. Breite, Civil Engineer. Mr. Breite is recognized as an authority in his field, and has had a good many years of experience in connection with the erection of buildings, including some of the notable business structures of San Francisco. He outlines briefly the history of the development of steel in this country, and points out the fact, which is often over-looked, that structural steel alone has made possible the modern sky-scraper.

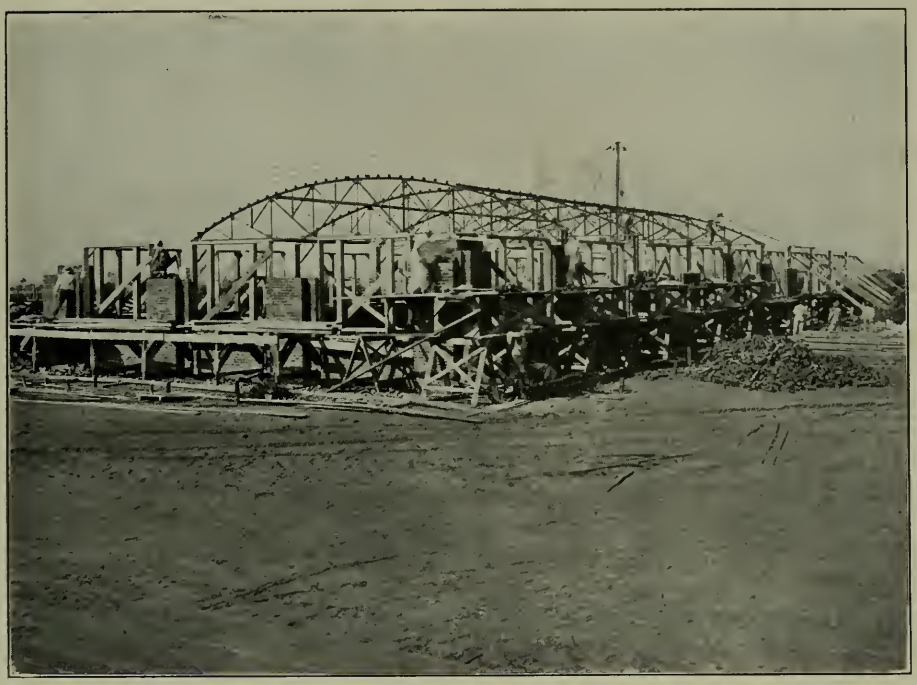


Steel frame of shelter erected at San Quentin Prison to protect inmates from the weather, and, at the same time, keep them in the open air.



Upper picture shows start of structure for the gymnasium, Brea-Olinda High School, Brea, California. Below is shown new building for Fairfax High School, Hollywood.

Upper picture shows a portion of the stock of structural material carried at our South San Francisco plant. Below is a factory building of George H. Morrill Co. of California, at South San Francisco, manufacturers of printing inks.



CALIFORNIA LEADS THE NATION IN BUILDING NEW SCHOOLS.—*The two views above show structural steel work of the Manual Arts Building, Brea-Olinda High School, Brea, California. The lower picture shows details of truss construction.*

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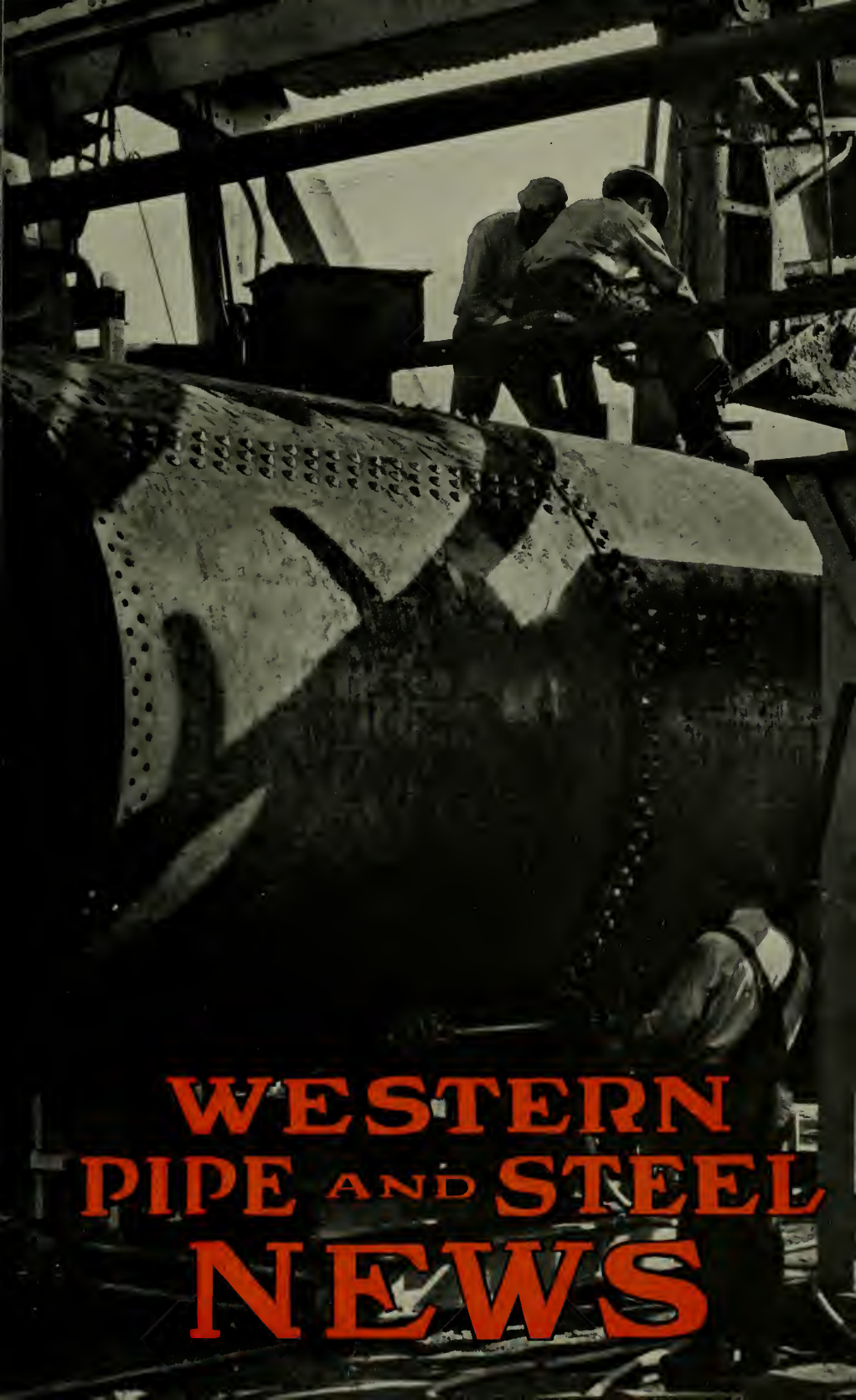

WESTERN PIPE AND STEEL NEWS

FABRICATING 110" DIAMETER RIVETED STEEL PIPE FOR CITY OF LOS ANGELES.—*This picture, taken at W. P. & S. Co.'s Los Angeles plant, shows bull riveter operating vertically instead of in the usual horizontal position. The immense size of pipe may be gauged by height of men on the staging.*

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SAN FRANCISCO - LOS ANGELES - FRESNO - TAFT - PHOENIX

VOLUME IV MARCH-APRIL, 1927 NUMBER 3

Los Angeles Builds New Haiwee Generating Plant With 9,600′ Penstock

By R. R. ROBERTSON, *Assistant Engineer, Construction Division, Bureau of Power and Light, City of Los Angeles.*

FOR the past fourteen years the City of Los Angeles has received its major water supply through the world-famous Los Angeles Aqueduct. Melting ice and snow on the eastern slopes of the High Sierras, perpetually feeding countless lakes and streams, furnish life-giving water to the great metropolis of the Southwest. The point of intake, where the water of the Owens River is diverted into the aqueduct, is 238 miles from Los Angeles, at an elevation of 3,714 feet.

However, it is the secondary factor of the utilization of this great water supply that concerns this article. The public is so accustomed to thinking of the Los Angeles aqueduct in terms of water supply only, that it seems fitting to present the facts regarding the latest step in the progress of the hydro-electric development that will always be a very important by-product of this system.

The newest unit, which is now under construction, is known as the Haiwee Generating Station, situated just below Haiwee Reservoir, which, with a capacity of 63,000 acre-feet, is the largest reservoir on the Los Angeles aqueduct system.

The site is approximately 180 miles from Los Angeles on the line of the aqueduct. The nearest railway station to the site is Little Lake.

Haiwee Generating Station will develop 4,800 K. W., or approximately 6,000 H. P., on a maximum flow of 400 second-feet of water. This plant is being built at this time as an assurance of power for pumping in the Owens Valley during low water seasons.

For the transmission of water from the reservoir to the generating station, the City of Los Angeles is constructing a penstock some 9,600 feet long, of riveted steel pipe of lap joint construction.

The diameter of this penstock is from 104″ to 90″, and steel plate used is from 5/16″ to 7/16″ thick. In the shop the pipe is made up in two-plate sections 16 feet in length. The field joints are connected in 32-foot lengths. It is estimated that about 2,000 tons of steel plates will be used in the entire plan.

An unusual feature of the project is the standpipe, which is 10 feet in diameter by 450 feet in length, and made of steel plates 7/16″ and 5/16″ in thickness.

The work of laying the pipe in the field began January 15, 1927, and June 1st is the date scheduled for completion. At the present time the field force numbers two hundred and fifty men. The pipe is all being placed in trench, except the 450-foot section of standpipe.

This is unusual practice, but was necessary in order to properly protect the

pipe line against debris from cloudbursts, which occur in the high country. At such times, enormous quantities of sand, rock and other materials are washed down with almost irresistible force.

A glance at the double panorama of pictures in the center spread of this magazine will give even the layman an idea of what cloudburst material might do to an unburied pipe line in such terrain as this. The upper picture particularly shows how cloudbursts carry material down from the High Sierra. This view was taken looking across the high mesa between Owens Valley and Rose Valley.

The steel pipe, which is about the same size as the riveted steel syphons in the original aqueduct line, is being coated with bituminous cement, the same coating first used on these syphons.

Western Pipe and Steel Co. of California is fabricating the riveted steel pipe for this project at their Los Angeles plant to a total of 8,100 feet, and also 450 feet of standpipe.

The pipe is loaded on flat cars at the Los Angeles plant of Western Pipe & Steel Co., and transported by railroad direct to the field. Each car carries two 16-foot sections of 104″ diameter riveted steel pipe with a similar section of smaller size nested inside.

This project is being carried out by the Bureau of Power & Light of the City of Los Angeles, which is under Mr. E. F. Scattergood as Chief Electrical Engineer and General Manager. The work of design and construction is being done by the Construction Division of the Bureau under Mr. H. C. Gardett, Electrical Engineer, and Mr. R. R. Robertson, Assistant Engineer. The field superintendent is Mr. C. W. Ragan.

City of Los Angeles pipe in yard at W. P. & S. plant, Los Angeles. These two-plate sections are 16 feet in length.

EDITOR'S NOTE—The particular attention of our readers is directed to the illustrations in this number of *Western Pipe & Steel News*. The cover picture, taken at our Los Angeles plant, is especially striking for three reasons: First, it is a real "action" picture; secondly, the pipe is of extraordinary size, being 110″ in diameter; and thirdly, the close-up view illustrates the triple riveted lap joints of the straight seams, and the double riveted lap joints of the round seams, as faithfully as though one were looking at the pipe itself instead of at a pictorial reproduction from a photograph.

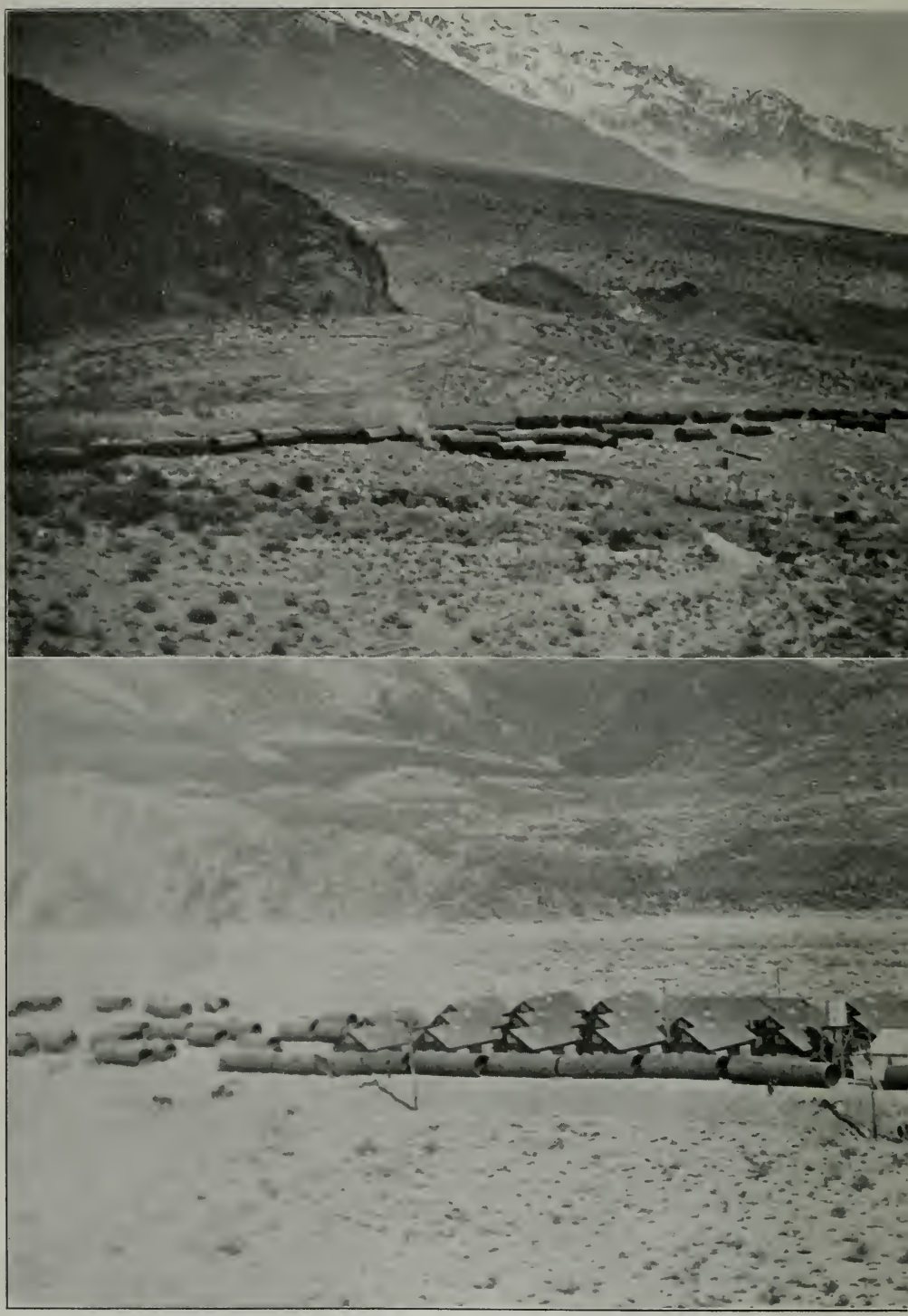
The other shop views are also worthy of special note, while the picture below shows the method of nesting one section within another for rail shipment. The field pictures were enlarged from snap-shots made by engineers in the field with small pocket kodaks, and they convey, better than words, the story of the installation of the pipe.

The following facts may be of interest in connection with Mr. Robertson's article on the Haiwee generating plant:

The Owens river has its source in the High Sierra approximately east of Yosemite Valley. Thus the stream draws from the highest mountains in the United States, among them Mt. Whitney, 14,501 feet. There are 82 lakes contributing to the water flow for the Los Angeles aqueduct, situated at altitudes varying from 6,000 to 12,000 feet.

The aqueduct from point of intake to the Alabama Hills is an open, unlined ditch. From the Alabama Hills to Haiwee reservoir it is a concrete lined canal. Below Haiwee reservoir the aqueduct is covered for its entire length. It crosses Rose Valley and then winds along the eastern slope of the Sierra, passing through some of the mountains by tunnels and crossing canyons by means of syphons.

Cars loaded and ready for shipment, Los Angeles plant. A pipe section of smaller diameter is nested inside 110″ sections.



PANORAMIC VIEWS ALONG THE LINE OF PENSTOCK FOR HAIWEE GENERATI

feet of riveted steel pipe from 104" to 90" in diameter. Because of cloudburst risks in this regi
Sierra in the background, shows the nature of the terrain. The bottom view shows the immense

LANT.—*Western Pipe & Steel Co. is supplying for this project of the City of Los Angeles 8,100 entire line is being buried in trench. The top picture, with the snow-covered slopes of the High f the pipe contrasted with the buildings in the construction camp.*

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IN a characteristically vigorous statement, Charles M. Schwab, one of the great leaders of the steel-making industry, recently paid his respects to the genius of the American engineers.

The editor deems it a privilege to reprint Mr. Schwab's statement:

"We marvel at the remarkable accomplishments of the engineering profession—the great railway and steamship lines of this country—automobiles and successful commercial airplanes—our massive hydro-electric and other power plants—gigantic irrigation systems — ponderous steel-making and scores of other industrial plants because we can see them—great, massive, throbbing, pulsating things before us.

"They are wonderful achievements. That is instantly apparent, but there is a phase of the work of the engineering profession with which the average layman is perhaps not so familiar and to which may be directly traced the prosperity of American industry.

"It is the constant struggle of American engineers for greater efficiency. The history of the profession fairly bristles with successful accomplishments in this direction.

"Present day industries are tremendously interested in any improvement or step which reduces the cost of production or operation and that is where our engineers have made truly remarkable strides.

"You enjoy an automobile on a fine paved highway or ride in comfort in a palatial train or steamship or in an airplane and you have countless other comforts at a reasonable cost because engineers have made it possible. We can't measure our indebtedness to them."

Los Angeles plant, W. P. & S. Co., showing 110" riveted steel pipe for City of Los Angeles penstock.

Caterpillar crane placing section of 110" pipe in trench. This section is a bend. Beneath and beyond is an engineer in action.

Field crew fitting a joint, City of Los Angeles penstock for new Haiwee Generating plant. The joints are double riveted lap joints.

The shop made up the Haiwee penstock in 16-foot sections, but in the field they were connected in 32-foot lengths before being lowered into the trench.

This view shows 110" pipe in trench with field joint being fitted up. The mountains in the background are the High Sierras.

FIELD INSTALLATION OF 110″ PENSTOCK FOR HAIWEE GENERATING STATION.—*It was deemed necessary to bury this pipe in trench to protect the line against possible damage that might be caused by debris from cloudbursts in this high country.*

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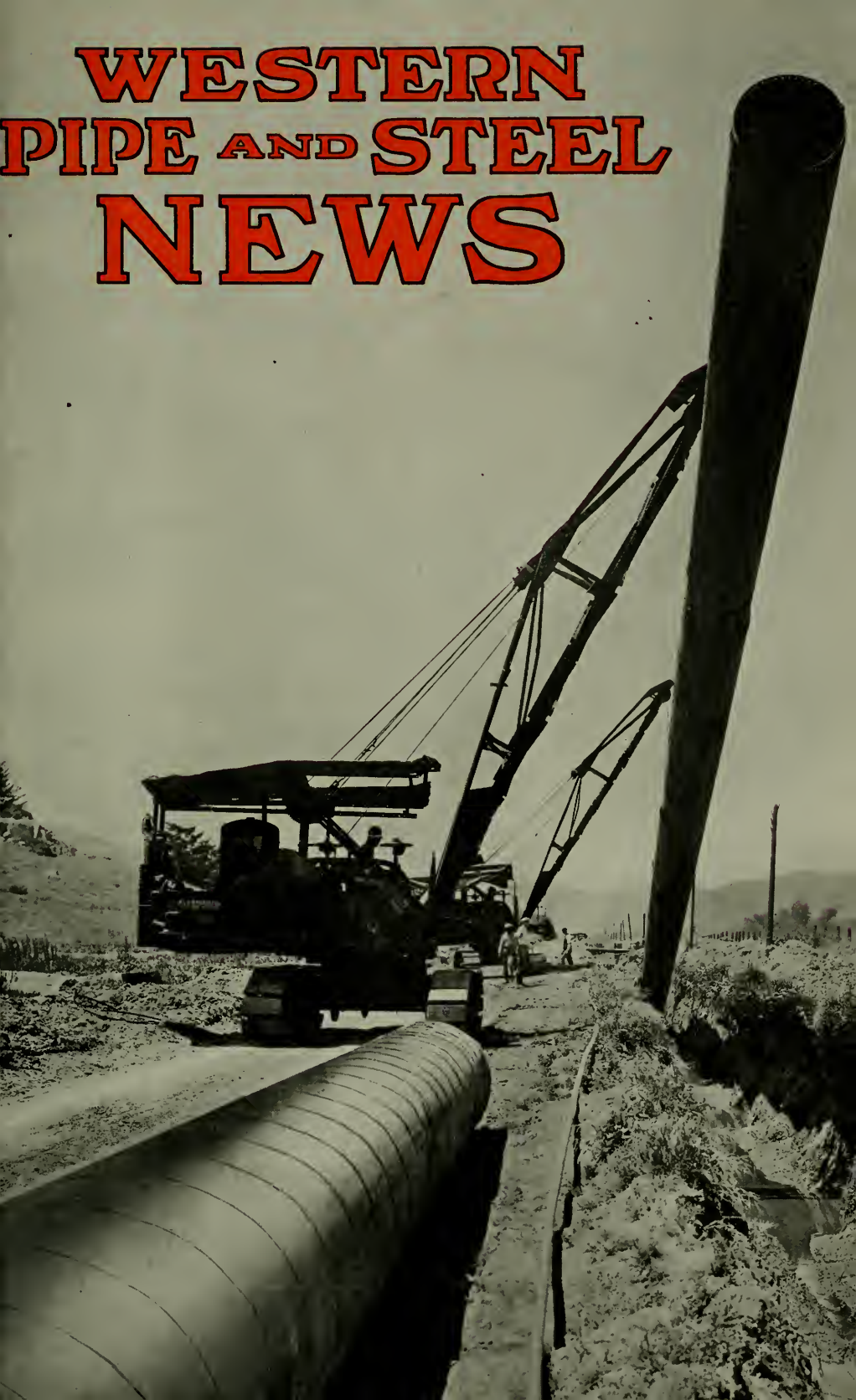
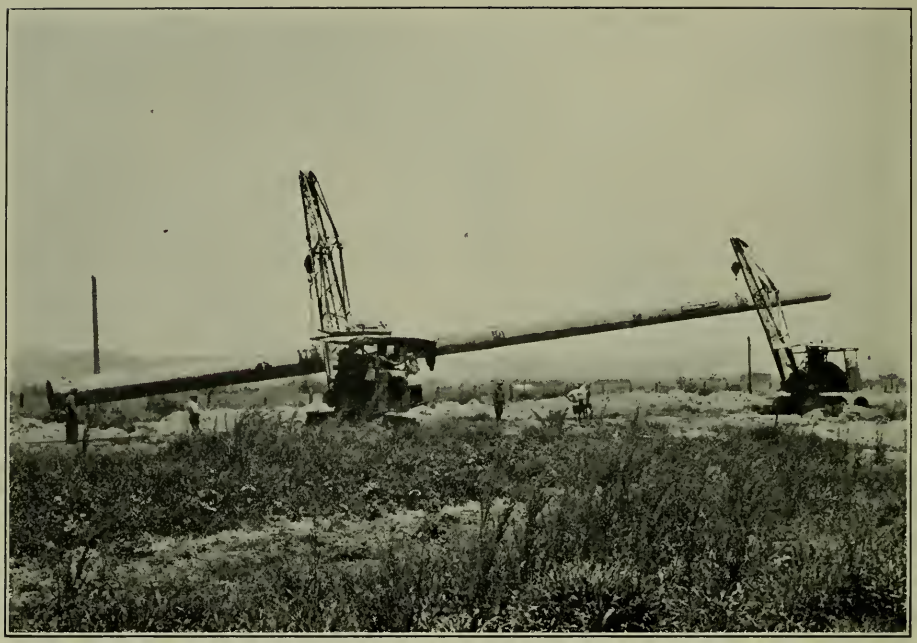
WESTERN PIPE AND STEEL NEWS





WESTERN PIPE & STEEL FIELD CREW INSTALLING 150′ SECTION OF 36″ STEEL PIPE.—*For the benefit of engineers and others interested we publish the above two pictures and the cover picture to illustrate an unusual feat in handling long and heavy pipe sections. These pictures were taken on the El Capitan pipe line of the City of San Diego.*

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Ten Commandments of Industry

By the HON. W. L. HUGGINS
Presiding Justice of the Kansas Industrial Court

TO ORGANIZED LABOR

1. Thou shalt not permit any of thy members to place the union card above our country's flag.
2. Thou shalt not deny to any man, at any time, at any place, the right to work as a free man and to receive wages as such.
3. Thou shalt not demand for any worker a good day's wages in return for a bad day's work.

TO CAPITAL

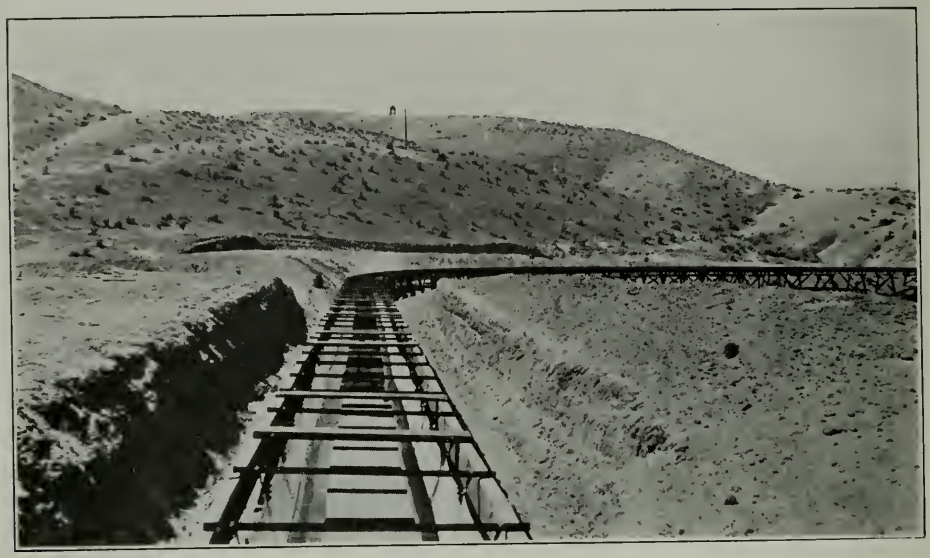
4. Thou shalt pay a fair living wage to each and every one of thy workers.
5. Thou shalt furnish a safe and healthful place in which, and safe appliances with which, thy employees may work.
6. Thou shalt operate thy business as continuously as its nature will permit, to the end that labor shall be regularly employed and that the public may not suffer for the living necessities furnished through the medium of thy activities.
7. Thou shalt not demand extortionate profits but shall be content with a fair return upon thy investment used and useful in thy business.

TO THE GENERAL PUBLIC

8. Thou shalt willingly pay a fair price for all commodities required by thee from labor and capital, to the end that labor shall have a just reward and capital a fair return.
9. Thou shalt pay thy taxes cheerfully and honestly, to the end that the obligations of the State to all its people may be promptly and properly fulfilled, liberty and justice safeguarded, and the general welfare assured.

TO EVERYBODY

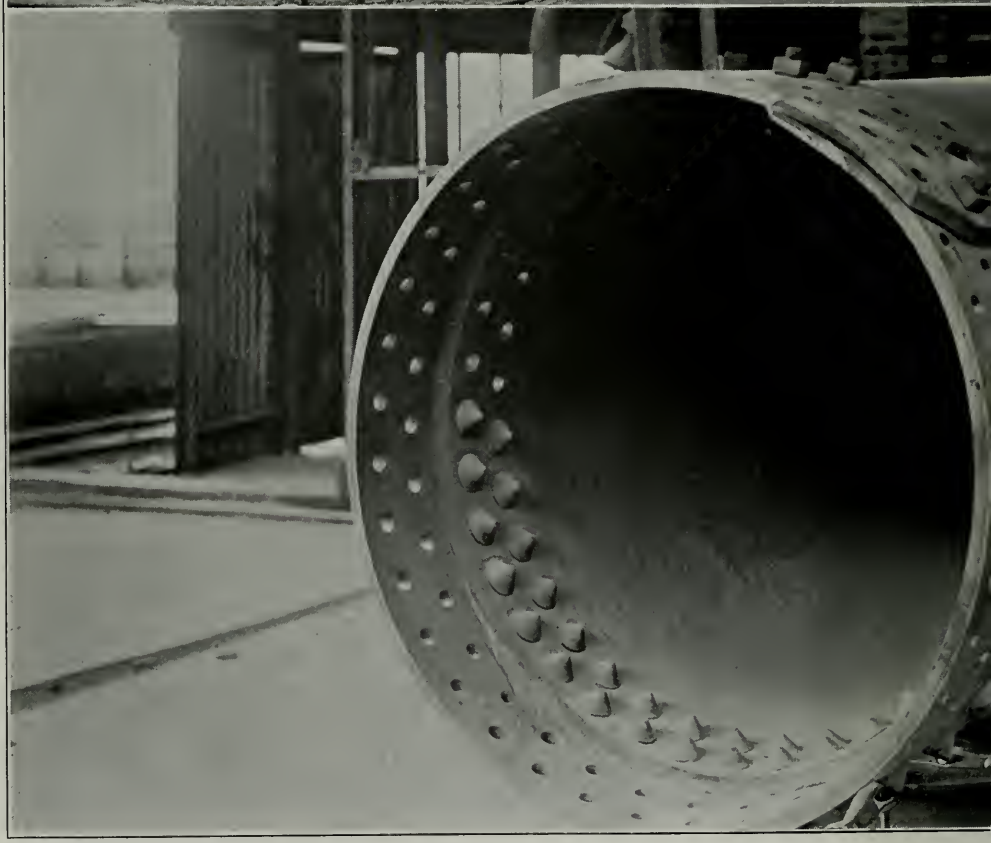
10. Thou shalt honor and love thy government, for it is the people's government, the best ever devised by man, and there is no other like it in the world.



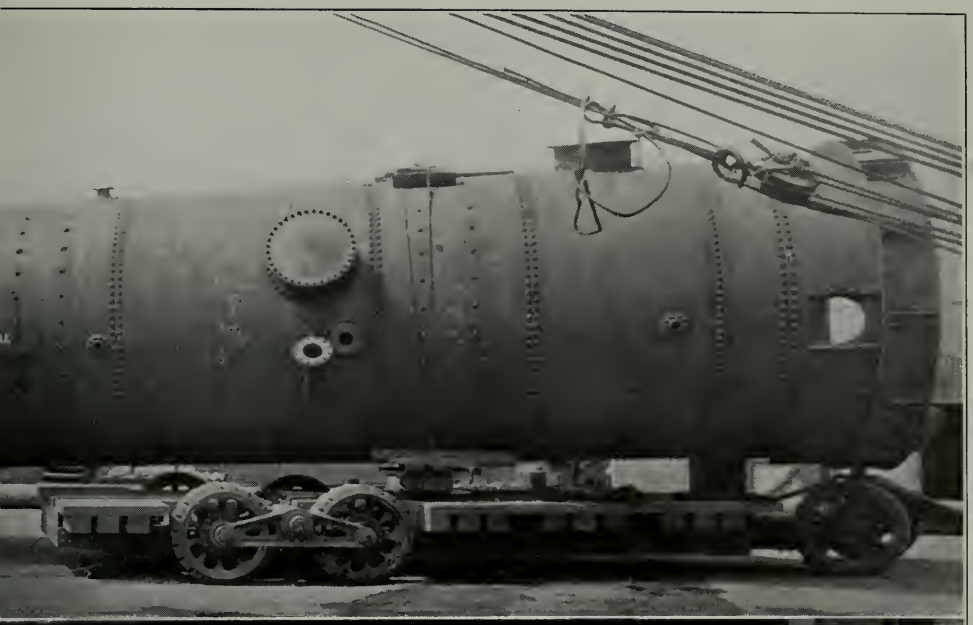
Steel flume has for years been a special product of W. P. & S. Co. The above picture was taken near Taft, Calif. The flume measures 30" across.

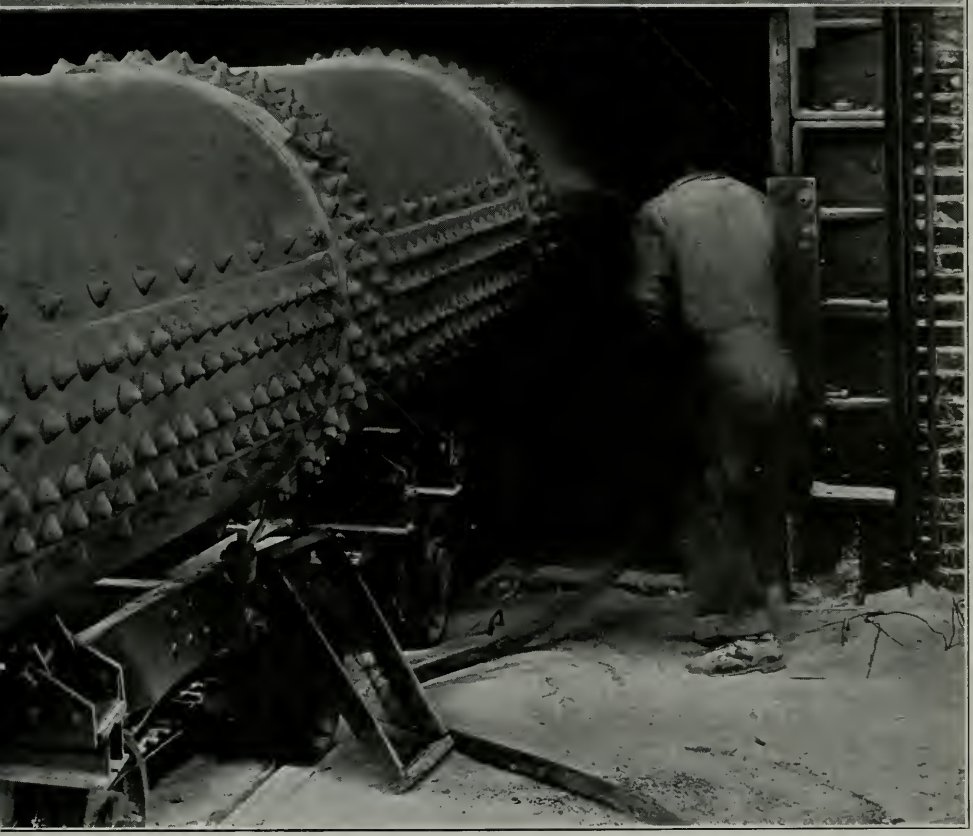
Western Pipe & Steel Co. supplied steel tunnel forms for the new Duboce-Sunset tunnel of the City of San Francisco. This picture was taken at the East Portal.

Western Pipe & Steel Co. recently completed this hemispherical bottom tank for the Yosemite Portland Cement Corp. at Merced. We also supplied structural steel, etc., for this plant.



ILLUSTRATING TWO VERY UNUSUAL PIECES OF HEAVY PLATE WORK FROM W. P. & S. CO.'S SHOPS.—*Top picture shows a Foster Fractionating Tower loaded on trucks at our Los Angeles plant to be transported to Richfield Oil Co.'s Rioco Refinery. This tower is 10′ 6″ in diameter, 81′ high and weighs 62 tons. From the standpoint of weight and dimensions, it is*





believed to be the largest single load ever handled on trucks. Lower picture shows a section of penstock 42" in diameter and made of 1¼" steel plate, designed to carry a pressure of 600 lbs. This section is undergoing the operation of sand-blasting.

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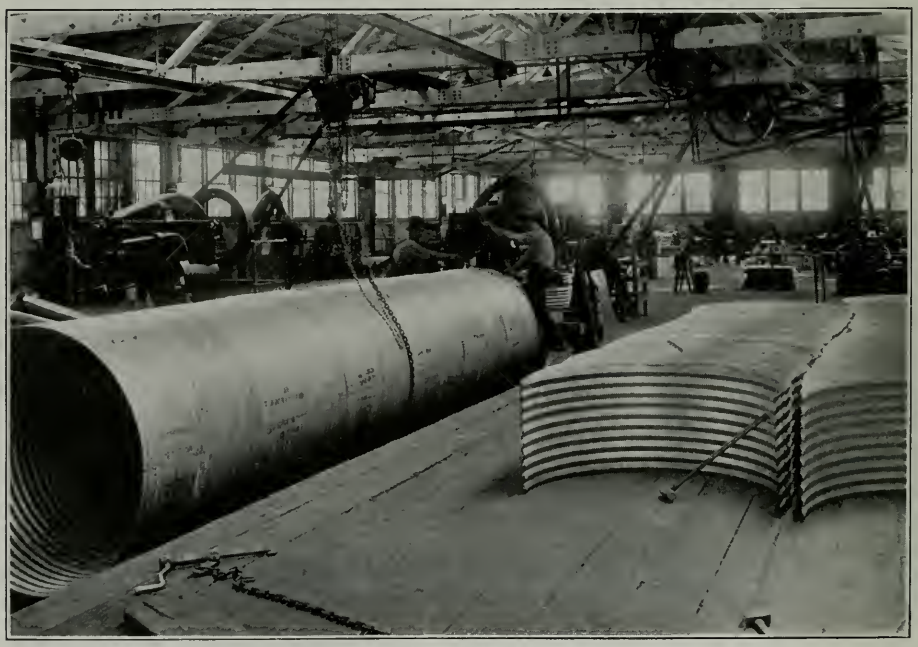
THERE is an ancient Chinese saying that one picture is worth ten thousand words. This has special application in connection with the fabrication and erection or installation of work of interest to engineers.

Western Pipe & Steel Co. of California has always recognized the usefulness of pictures. It has been, for years, the rule at all of our five plants to make a photographic record of interesting and unusual work from the beginning of the process of fabrication right through to completion.

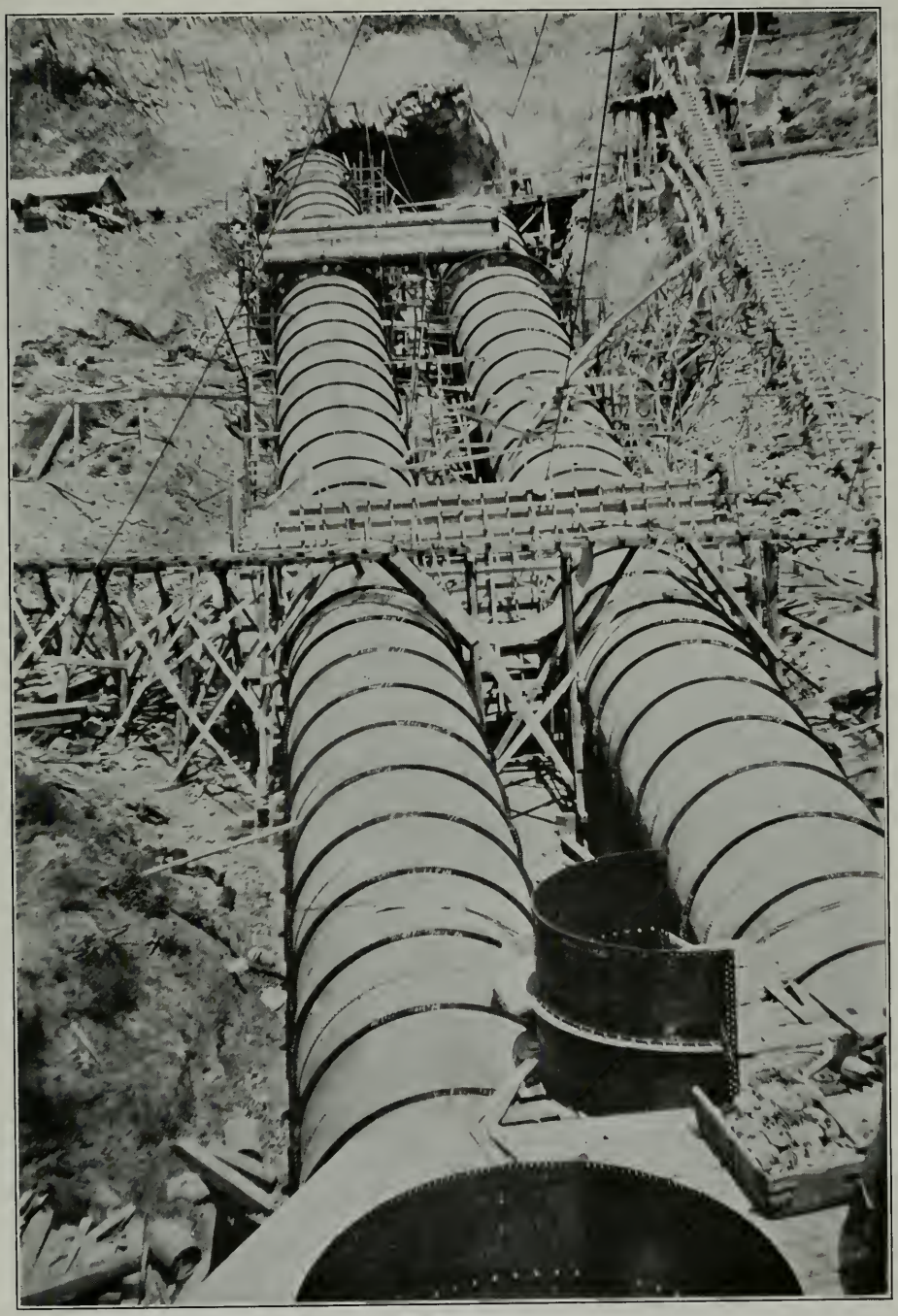
During the last three and one-half years, the pick of these pictures have been presented to the readers of WESTERN PIPE AND STEEL NEWS. Others have been utilized in our catalogue, which has been praised by many engineers as a model of this type of illustrated catalogue.

Every picture tells its own story, as, for instance, the cover of this issue, which is a particularly apt illustration of what the Chinese proverb-maker meant. Ten thousand words would not tell an engineer half so well as does this picture, the story of the two caterpillar cranes handling a 150′ section of pipe. The picture tells everything except weight and dimensions, and these can be covered in a sentence. The section weighs 243 lbs. per foot, or a total of 36,450 lbs., slightly over 18 tons; it is 36″ in diameter and made of steel plate ½″ thick. The pipe is Lockbar, with soil proof covering, and was fabricated in our shops for the City of San Diego.

The pictures in this number embrace a wide range of products. They are supplemented by a complete list printed on the inside back cover. We suggest that purchasing agents file this list for future reference.



The fabrication of galvanized corrugated culverts is an important W. P. & S. activity. The above view, taken at the South San Francisco plant, shows 60″ culvert.



These twin penstocks were fabricated by Western Pipe & Steel Co. for California Oregon Power Co., Copco plant No. 2. Each penstock is 13'6" in diameter x 400' long.

Installation of steel tanks at Pacific Coast Plant of Geo. H. Morrill Co. of California at South San Francisco, manufacturers of printing inks.

Shop assembly of Tainter Radial Gates, fabricated by W. P. & S. for Joshua Hendy Iron Works, and shipped to Northwestern Power & Light Corp., Port Angeles, Washington, for Glines Canyon Power Plant.

PURCHASING AGENTS' REFERENCE LIST OF PRODUCTS

MANUFACTURED BY

Western Pipe & Steel Co.

OF CALIFORNIA

Absorption Plants
Accessories, Oil
Accumulators
Acid Tanks
Agitators
Air Condensers
Air Receivers
Air Pipe

Black Steel Tanks
Boilers
Bolted Tanks
Braces, Pressed Steel Car
Brine Tanks
Buildings, Steel
Burners, Refuse

Car Sills, Pressed Steel
Casing, Oil Well
Casing, Water Well
Condenser Boxes
Cooling Towers
Corrugated Culverts
Corrugated Tanks
Culverts, Metal

Dephlegmators
Dredge Pipe

Evaporators

Filters
Fire Stills
Flumes, Steel
Fuel Oil Storage Tanks

Galvanized Air Pipe
Galvanized Culverts
Galvanized Irrigation Pipe
Galvanized Tanks, Corrugated
Galvanized Tanks, Straight Side
Gas Holders
Gas Traps
Gasoline Storage Tanks
Gasometers
General Plate Work
Gravity Tanks
Grease Kettles

Heat Exchangers
Heaters
Hemispherical Bottom Tanks
Holders, Gas
Hydro-Pneumatic Pressure Tanks

Ice Cans
Irrigation Pipe, Galvanized

Kettles, Grease
Kettles, Steam Jacketed

Lock-Bar Steel Pipe

Metal Culverts
Metal Flumes

Oil Accessories
Oil and Gas Separators
Oil Refinery Equipment
Oil Storage Tanks, Steel
Oil Well Casing

Parts, Pressed Steel
Penstocks, Steel
Pipe, Dredge
Pipe, Galvanized Air
Pipe, Galvanized Irrigation
Pipe, Gas Gathering
Pipe, Lock-Bar Steel
Pipe, Riveted Steel
Pipe, Slip-Joint
Pipe, Soil Proof
Pipe, Steel
Pipe, Welded
Pressed Steel Work
Pressure Tanks
Purifier Boxes

Receivers, Air
Refinery Equipment
Refuse Burners
Retorts
Riveted Steel Pipe
Riveted Steel Tanks
Rock Screens
Roof Pressure Tanks

Smokestacks
Soil Proof Pipe
Special Fittings
Special Shapes
Special Tanks
Standpipes
Station Tanks
Steam Stills
Steel Buildings
Steel Flumes
Steel Penstocks
Steel Pipe
Steel Plate Construction
Steel Tanks
Stills
Storage Tanks, Steel
Stovepipe Casing
Structural Steel Work

Tanks, Acid
Tanks, Bolted
Tanks, Black Steel
Tanks, Brine
Tanks, Cylindrical
Tanks, Galvanized Corrugated
Tanks, Galvanized Straight Side
Tanks, Gravity
Tanks, Hemispherical Bottom
Tanks, Hydro-Pneumatic Pressure
Tanks, Oil Storage
Tanks, Pressure
Tanks, Riveted
Tanks, Roof
Tanks, Shaped
Tanks, Ship
Tanks, Tower
Tanks, Truck Single or Multiple Compartments
Tanks, Wagon
Tanks, Welded
Towers, Cooling
Towers, Steel Tank
Traps, Gas

Wagon Tanks
Water Pipe Lines
Water Well Casing
Welded Pipe
Welded Tanks
Wrapped Pipe

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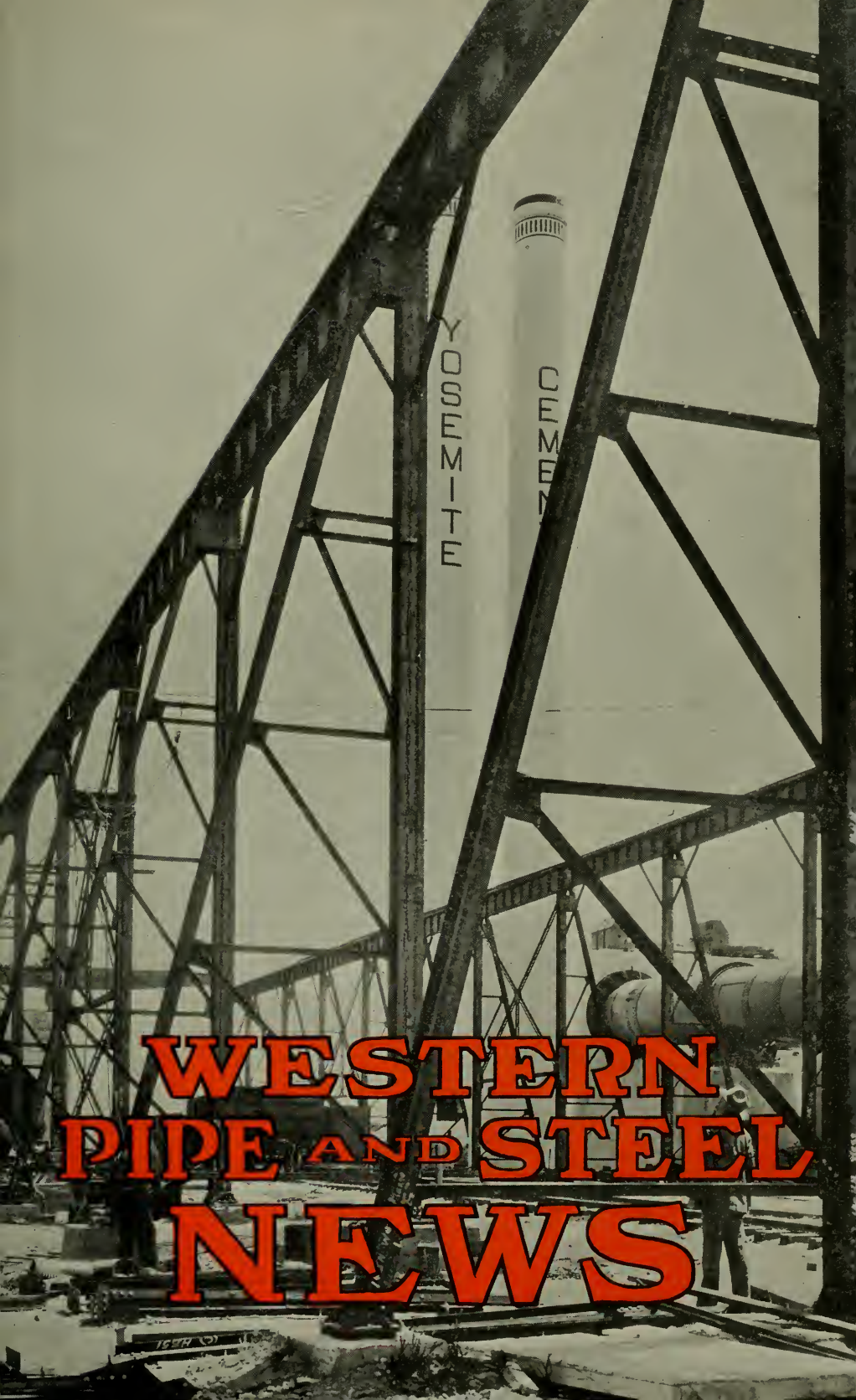

WESTERN PIPE AND STEEL NEWS

HEMISPHERICAL BOTTOM TANKS ARE A WESTERN PIPE & STEEL SPECIALTY.—*Above tank was erected at the new Merced plant of the Yosemite Portland Cement Corporation. Its capacity is 50,000 gallons.*

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VOLUME IV JUNE, 1927 NUMBER 5

Yosemite Portland Cement Corporation Completes New Merced Plant

By G. A. Fisher, Superintendent
Yosemite Portland Cement Corporation

THE new, modern plant of the Yosemite Portland Cement Corporation, at Merced, California, is rapidly nearing completion. The opening date has been set for July 16. The plant is located about two and one-half miles northwest of Merced, and its stacks, slurry tanks and storage silos may be seen for miles from the railroads and inland route of the State Highway.

The plant is of the latest type, wet process, and will be electrically operated. Power is furnished by the San Joaquin Light & Power Corporation. The plant has two kilns, 10 feet in diameter by 240 feet long, and its capacity will be at least 2,500 barrels of cement per day. It is served by three railroads, which have extended their tracks to the millsite.

The limestone is obtained from the corporation's quarries at Emory, a station in the Merced River Canyon on the line of the Yosemite Valley Railroad, and also on the new all-year State Highway leading into Yosemite National Park. Emory is only a few miles west of the entrance of the National playground. The limestone deposit covers between four and five hundred acres, and, according to estimates made by several engineers, contains sufficient high grade rock to run the plant, even at an increased capacity, for more than a hundred years.

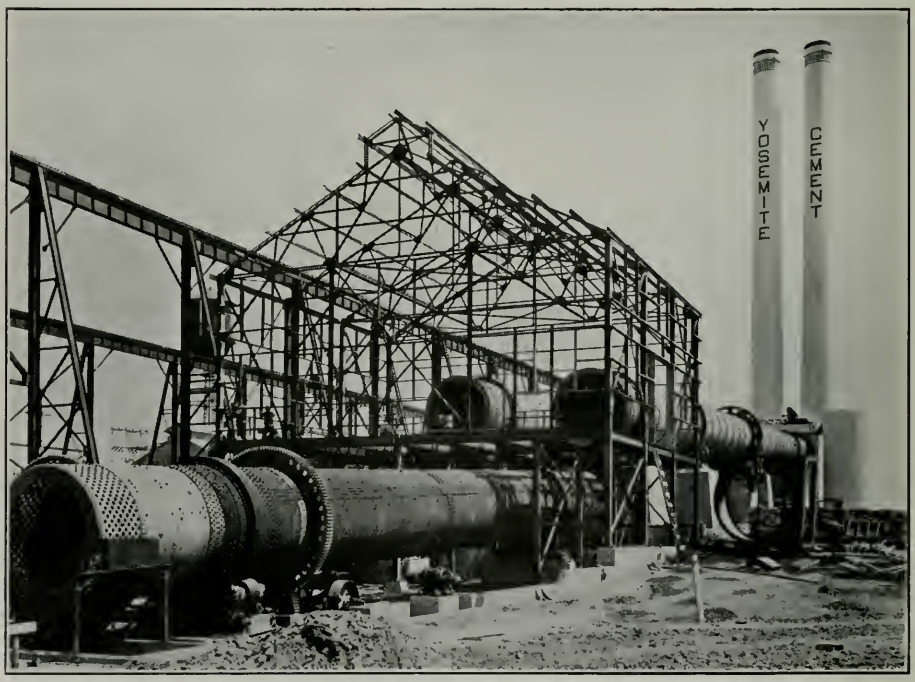
The quarry opening is at an elevation of about eight hundred feet above the line of the Yosemite Valley Railroad. At this point it is possible to open a face 3,000 feet in length with a possible height of 500 feet. The limestone lies at an angle of approximately 70 degrees from the horizontal and the quarry opening is on the upper or hanging wall side. This makes an ideal condition from a safety standpoint and at the same time will reduce the powder cost to a minimum.

Rock will be loaded into side-dump cars by an electric shovel and will then be transported some 2,000 feet to the crushing plant, where it will be dumped into a gyratory crusher to be crushed to 8 inches in size. From the gyratory crusher the rock falls on to a Sheridan "Grizzly," which takes out all material smaller than one inch. This Sheridan Grizzly discharges all oversize rock into a "Jumbo" mill, from which it is carried by a 30-inch belt conveyor to the bunkers, which have a capacity of 600 tons.

From the bunkers 20-ton cars are filled and lowered to the main railroad level by means of a tandem drum hoist. It is then dumped into the loading bunkers, from which it is loaded through specially designed steel chutes, furnished by the Western Pipe & Steel Company, into bottom dump cars on the Yosemite Valley Railroad and hauled to the plant site, some sixty miles distant.

Clay will be shipped from a deposit located one and one-half miles from Carbondale. This deposit consists of some 200 acres of clay land with a clay depth of from 20 to 30 feet. This clay has a very high aluminum content and is of an extremely plastic nature, breaking down without any appearance of grit, and is ideal for the manufacture of cement.

Upon arrival at the plant site, the rock and clay will be unloaded from bottom dump cars into a pocket, from which a 24-inch belt conveyor will carry the rock to the raw compeb mill bins and the clay to a 26-foot wash mill. Any surplus of either material will be by-passed to a point under the storage crane. This traveling crane, which is supported on heavy structural steel runways furnished by the Western Pipe & Steel Company, is one of the unique features of the mill. It has a 70-foot span, is approximately 600 feet long and is equipped with a three-yard clam shell bucket. It runs parallel to the kilns, thus making it possible for one crane to handle clay and rock in and out of storage, clinker in and out of storage, and also unload from cars



Progress picture taken at Merced during construction of Yosemite Portland Cement Corporation's new plant. Structural steel, etc., furnished by Western Pipe & Steel Co.

and feed it into the gypsum bins in the finish mill, which were furnished by Western Pipe & Steel Company. The storage capacity for raw material will be 35,000 tons of rock and clay, 100,000 barrels of clinker, and several thousand tons of gypsum.

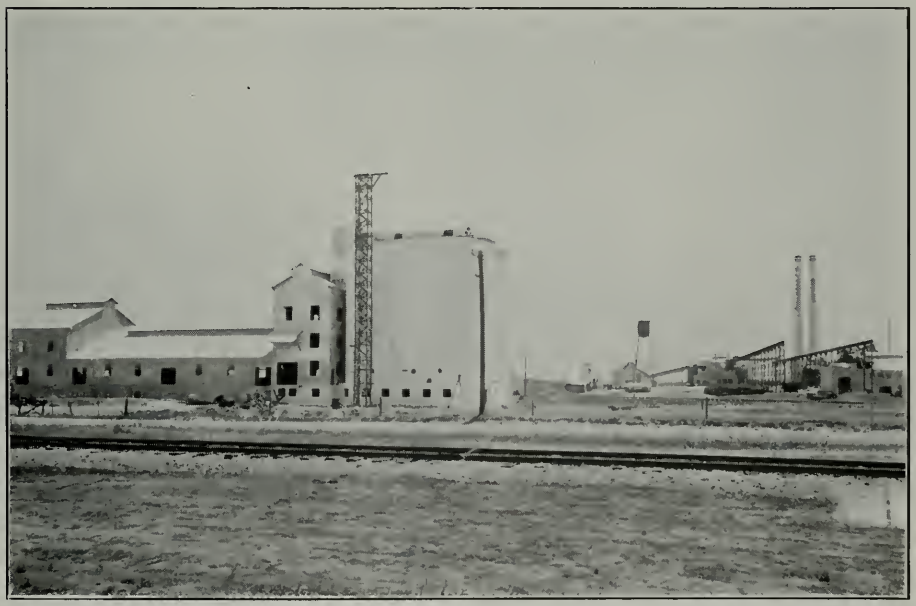
Water is furnished from wells 168 to 258 feet deep and pressure is maintained from a 50,000-gallon hemispherical bottom water tank on steel tower manufactured and erected by the Western Pipe & Steel Company.

All structural steel buildings, in which over 650 tons of steel were used, were fabricated and erected by Western Pipe & Steel Company. The structural work, as well as all other material fabricated by Western Pipe & Steel Company, was eminently satisfactory, and the service was highly commendable.

The plant has been designed and laid out so that its capacity may be doubled or trebled without interfering with the daily operation of the present units.

Construction and installation were under the direction of George A. Fisher, superintendent, with the Stevenson Engineering Corporation of San Francisco and Harold K. Fox, engineer for the San Joaquin Light & Power Corporation, as consulting engineers on plans and designs. Mr. Fisher will continue in charge of operation when the plant is completed.

A. Emory Wishon, one of the best known industrial executives on the Pacific Coast, heads the Yosemite Portland Cement Corporation as president, and Murray Bourne, chief counsel for the San Joaquin Light & Power Corporation, is secretary. These men, together with John B. Olcese and W. A. Sutherland, form the directorate.



Yosemite Portland Cement Corporation's new Merced plant as it appears today, ready for operation.

YOSEMITE PORTLAND CEMENT CORPORATION'S NEW PLANT AT MERCED, WHICH HAS JUST BEEN COMPLETED.—*Western Pipe & Steel Co. of California furnished a large portion of the material that went into this factory. This included all structural steel for buildings; structural steel for the huge craneway which runs the length*

f the plant, 600′ and with 70′ span; 50,000 gallon hemispherical bottom tank on tower; eel chutes for the loading bunkers; steel bins to hold gypsum, etc. The plant will begin perations with an output of 2,500 barrels of cement per day, but it has been so designed hat its capacity may be doubled or trebled at any time without shutting down.

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EDITED BY RICHARD PROSSER

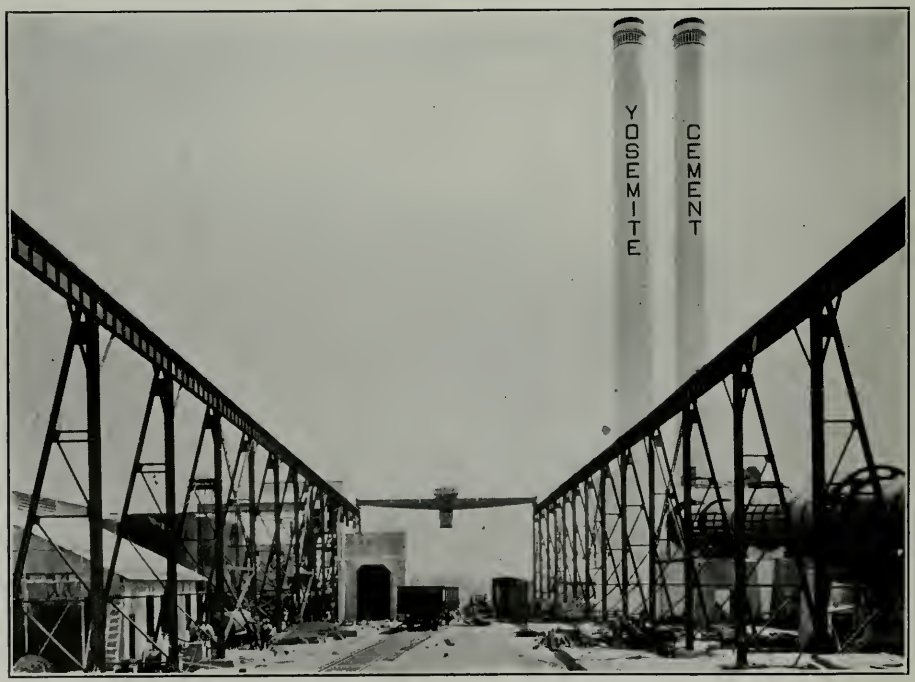
WESTERN PIPE & STEEL COMPANY OF CALIFORNIA expresses, in this issue, its congratulations to the Yosemite Portland Cement Corporation on the opening of its new plant at Merced. We particularly compliment Mr. A. Emory Wishon, president of the company, and his fellow-officers, on the consummation of their project.

This new plant, which is one of the most modern cement factories in the country, marks another brilliant chapter in the record of California industry. It is a monument to the enterprise and vision of the group of men behind it.

Western Pipe & Steel Company is proud of the fact that it was called upon to furnish a considerable part of the material and equipment that went into the construction of this factory. This included the fabrication and erection of all structural steel, not only for the buildings, but also for the huge craneway.

Other items supplied by this company were a 50,000-gallon hemispherical bottom tank on a steel tower; steel chutes for the loading bunkers; steel bins for holding gypsum, and various other equipment.

To our congratulations to the Yosemite Portland Cement Corporation we wish to add the prediction that the enterprise will meet with the success that its sponsors deserve. With an initial capacity of 2,500 barrels of cement per day, the plant has been so designed that its capacity may be increased in any desired degree almost at a moment's notice.



This picture and the one reproduced on our front cover show detail construction of craneway built for Yosemite Portland Cement Corporation's new Merced plant. It is 600′ long, with 70′ span.

Los Angeles Aqueduct Repaired

A SHORT TIME AGO the telegraph wires were humming with stories of the dynamiting of the Los Angeles Aqueduct. To engineers these attempts to cripple, even destroy, the water supply of the City of Los Angeles meant emergency repairs of the most urgent nature conceivable.

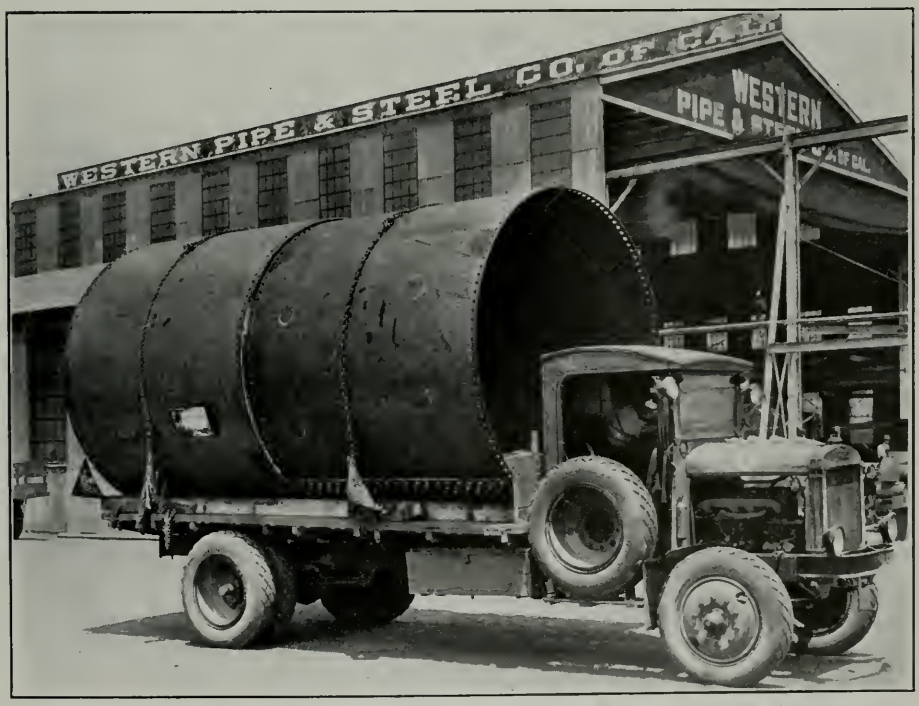
That the repairs were made in record time is by now a matter of engineering history. That Western Pipe & Steel Company was called upon in the emergency is a source of great pride to this organization.

The order for the pipe needed to repair the break was received at our Los Angeles plant May 27th. The major portion of the pipe was delivered on May 29th, less than forty-eight hours after receipt of the order, and delivery was completed on May 31st. On the latter date, however, only one or two sections were delivered, the bulk of the work having been completed on the 29th.

The pipe required for the repair of the aqueduct consisted of 104 feet of riveted steel pipe 9′ 3″ in diameter and 9/16″ thick; 96 feet of pipe 9′ 3″ in diameter of ½″ plate; and 40 feet of pipe 9′ 3″ in diameter of ¼″ plate.

The work went through our Los Angeles plant on a twenty-four hour basis, the crews working continuously through a Sunday and a holiday in order to accommodate the City of Los Angeles in its emergency.

The picture below shows the first two sections of pipe leaving our Los Angeles plant for the scene of the break.



The first two sections of pipe for the repair of the Los Angeles Aqueduct leaving Western Pipe & Steel Los Angeles plant. This work was turned out in record time.

Riveted Pipe in Severe Test

In the year 1914, Western Pipe & Steel Company fabricated and installed for the City of San Diego a 28″ riveted steel pipe line to serve as a transmission line for water from the Lower Otay reservoir. This line, with a carrying capacity of 5,000,000 gallons daily, is an important factor in the water supply of the city.

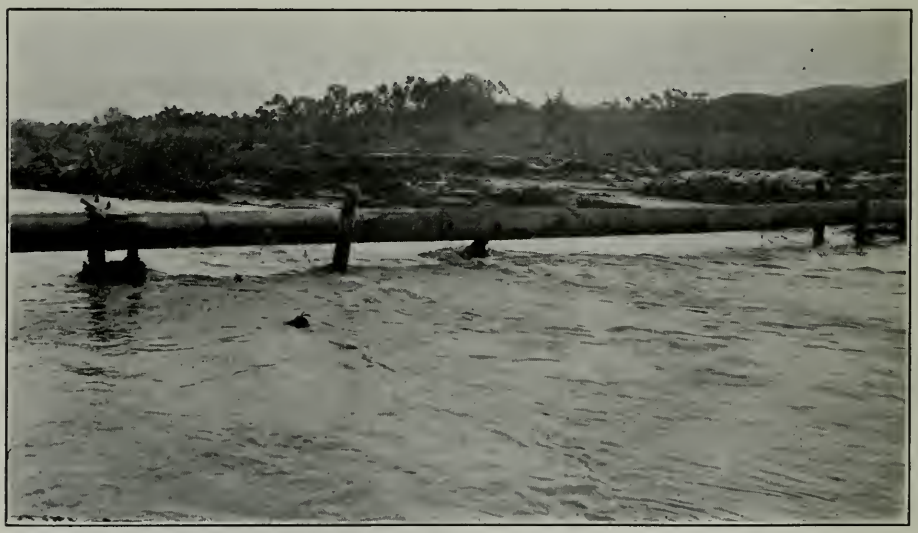
Some ten years ago this pipe line was subjected to severe flood conditions, necessitating new pile supports. The exceptional rainstorms of last February found these supports badly rotted, and the changing of the course of the stream carried many of them away.

The Sweetwater River is ordinarily a peaceful stream, but the heavy rainstorms converted it into a raging torrent that swept away the supports and left seven full sections of pipe hanging in mid-air for a distance of over 100 feet. In spite of the terrific strain that was thus put upon it—and the line still continued to carry its full capacity—the pipe held, not a rivet pulled.

Of course, immediate steps were taken to prevent a break, and keep the line in service until new supports could be constructed. This was done by erecting "A" frames at each end of the unsupported section, between which a 1¼″ cable was stretched. Over this cable were looped hangers of ¾″ steel cable in which the pipe was slung. This is illustrated on the opposite page.

It goes without saying, of course, that the manner in which this riveted steel pipe stood up under such a severe strain is a wonderful tribute to this type of construction. That the line did not break was remarkable. That not a single rivet pulled was phenomenal. The pictures tell the story eloquently.

Editor's Note.—The above data and the picture below and on the opposite page were supplied through the courtesy of Mr. Paul J. Kelsey of the Operating Department, Water Impounding Bureau, City of San Diego.



A view of pipe line across Sweetwater River, showing how flood washed out supports.

EMERGENCY SUPPORTS FOR RIVETED STEEL PIPE LINE IN SAN DIEGO COUNTY.—*When floods washed away the supports for this pipe line, the above illustrated method was used to support it temporarily. The operation is described on the opposite page.*

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WESTERN PIPE AND STEEL NEWS

WESTERN PIPE & STEEL CO. INSTALLS NEW LINE FOR SAN JOSE WATER WORKS.—*This view, taken on Alum Rock avenue near Capitol avenue, shows new 16" welded pipe being placed in trench. Line passes under street railway at this point. The line consists of 20,000 feet of soil-proofed pipe.*

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San Jose Host to American Water Works Association, California Section, October 5-8

By H. S. KITTREDGE, Secretary
San Jose Water Works

To San Jose has fallen the honor of entertaining the California Section of the American Water Works Association during its eighth annual convention, which will be held this year from October 5th to 8th. The Garden City of the Santa Clara Valley is deeply sensitive of the compliment conveyed in its selection for this notable gathering, and is preparing to measure up to the opportunities and the responsibilities of the occasion.

We are informed that reservations to date indicate that this meeting of the association will surpass in attendance all previous sessions, including last year's convention at San Diego, which, it will be recalled, set a new record. This may easily happen since San Jose is a central point and therefore conveniently accessible to all members. I should like to say here, however, that if we surpass San Diego in other ways than attendance, we shall be indeed fortunate.

Headquarters for the convention will be at the Hotels St. Claire and Vendome. The exhibits will be housed in the Scottish Rite Temple at Third and St. James streets. Social activities will include a golf tournament at the San Jose Country Club on Wednesday, October 5th; an informal dinner at the Hotel St. Claire on Thursday evening with former U. S. Senator James D. Phelan as the principal speaker; and on Friday evening, at the Hotel Vendome, the Exhibitors' annual dinner-dance.

Members of the Association have been officially advised of the program arranged for the business sessions of the convention, and therefore these details may be omitted here.

At the request of the editor of WESTERN PIPE AND STEEL NEWS, the following outline of the San Jose water system has been prepared, as a matter of advance interest to Association members:

The estimated population of San Jose and vicinity is 70,000; Los Gatos and vicinity 6,100; Saratoga and vicinity 1,100. We thus serve a population close to 80,000. The system includes 288 miles of pipe.

The annual consumption of water is approximately 2,400,000,000 gallons; the daily consumption is 5,000,000 gallons in the winter to 10,000,000 gallons in the summer time. The daily per capita consumption is 90 gallons.

The water used by the San Jose Water Company is derived from two

general sources of supply — surface waters gathered in the Santa Cruz mountains, which form the barrier between Santa Clara Valley and the ocean, and subterranean waters drawn from the deep gravel measures underlying the Santa Clara Valley.

The mountain supply is obtained from the catchment area of Los Gatos Creek, the largest stream on the east slope of the Santa Cruz mountains. Water is diverted at several points in the watershed of Los Gatos Creek. Reservoirs are used for storing flood waters with which to augment the summer flow of the stream. The Williams, Howells and Lake Ranch Reservoirs are the principal ones used for this purpose, the stored water being drawn from the reservoirs as needed and conducted down the creek channel through lands owned by the San Jose Water Company. The ownership of these lands insures the continued purity of the water, and is the only means whereby the supply may be effectively guarded against contamination.

In addition to the surface supply, the San Jose Water Company draws water from deep wells in and near the City of San Jose. These wells vary in depth up to 1,530 feet and are bored with diameters from 8″ to 20″. They tap the deep gravel measures underlying the Santa Clara Valley. Owing to the great depth of the source the supply is absolutely pure in quality and uniform in quantity.

These gravels occur in lenticular form and are the remnants of ancient streams which crossed and recrossed the valley floor, swinging pendulum-like from one side of the valley to the other as the beds of the old streams were built up by the dep-

Western Pipe and Steel Company fabricated and installed this new pipeline for the San Jose Water Works. The line is 20,000 feet long, the pipe being 16″ diameter, electrically welded and covered with soil-proof wrapping.

osition of gravel, sand, and clay carried down during floods from the surrounding mountains. The alluvium deposited in this manner and now forming the valley floor probably has a depth of over 2,000 feet, forming a vast underground reservoir which is tapped by the deep wells of the San Jose Water Company.

The Tisdale Pump Station is operated by electric power, and has a capacity of 1,400 gallons per minute. This station pumps from Tisdale Reservoir into the Los Gatos system, and may also be used to pump into the Mountain Springs reservoir, using the Los Gatos distributing system as a conduit for this purpose.

The Buena Vista Pump Station is equipped with electrically operated pumps, and has a capacity of 3,600,000 gallons per day. Water is drawn from deep wells by means of small multiple-stage turbine pumps placed in the well casings, discharging into a tank from which it is pumped directly into the San Jose distributing system.

The Main Pump Station, located at Santa Clara avenue and River street is an electric plant, having a total capacity of 5,760,000 gallons in twenty-four hours.

The Seventeenth street Pump Station is electrically operated, and has a capacity of 4,610,000 gallons per day. It pumps from deep artesian wells directly into the San Jose distributing system. Water is supplied

(Continued on Page Eight)

Another view taken along Alum Rock avenue, San Jose, showing installation of new transmission line for the San Jose Water Works. Pipe was fabricated at South San Francisco.

SCENE ALONG ALUM ROCK AVENUE, SAN JOSE, SHOWING WESTERN PIPE AN
STEEL FIELD CREW INSTALLING PIPELINE.—*This new line for the San Jose Water Wor*
consists of 20,000 feet of 16" electrically welded steel pipe made of 3/16" plate. The pipe w

bricated at Western Pipe and Steel Company's South San Francisco plant. It is covered with l-proof wrapping. The line is designed to supply water from the distributing system of the n Jose Water Works to the East Side District.

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WE TAKE pleasure in presenting in this issue of WESTERN PIPE AND STEEL NEWS an article by H. S. Kittredge, secretary of the San Jose Water Works.

This article should be of special interest in view of the approaching convention of the California section of the American Water Works Association, which will be held at San Jose from October 5th to 8th, inclusive. Mr. Kittredge has given an interesting outline of the San Jose Water Works. There is no doubt but what a majority of those who will attend the convention will inspect the system.

This article will, it is hoped, give the delegates some light on the subject in advance.

Most of the illustrations in this number show the new pipeline fabricated and installed for the San Jose Water Works by Western Pipe and Steel Company. This new pipeline is described in Mr. Kittredge's article.

It consists of approximately 20,000 feet of 16″ diameter 3/16″ welded steel pipe, with soil-proof covering and is designed to serve the East Side District. Western Pipe and Steel Company is also supplying 6,000 feet of 12″, #10 gauge welded pipe; 2,200 feet of 10″, #10 gauge and several steel tanks, the largest of which has a capacity of 300,000 gallons.

This view shows a well rig in the Salinas Valley, where Western Pipe and Steel Company has been furnishing Hard Red Steel well casing for many years.

Salinas Valley

The Salinas Valley, which is one of the most fertile and prosperous regions in California, is located about 100 miles south of San Francisco. It is about 100 miles long, running in a general southerly direction. Salinas, the county seat of Monterey County, is situated in the lower valley.

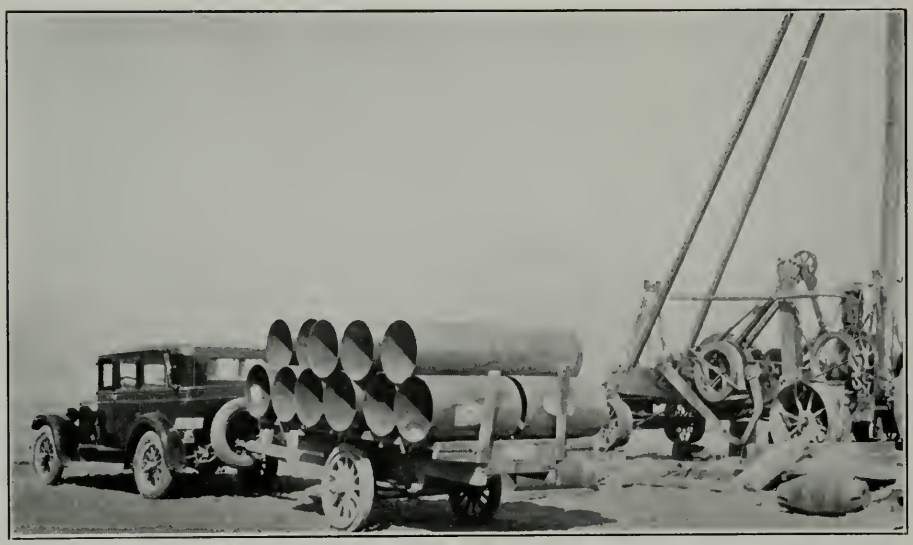
It has long been noted for its large irrigation development. In a recent year, over 100 large new irrigation wells were bored. The rainfall in the district averages from 15 to 18 inches per year. Because of the underground flow of the Salinas river, very slight irrigation is required in certain parts.

For many years Western Pipe and Steel Company of California has been a large factor in supplying well casing in this part of the State.

Our experience led us long ago to the conclusion that the best material for water well casing is Hard Red Steel, which we use exclusively in the manufacture of this product. The importance of exactness and careful work is given due emphasis. Every joint is lathe-trimmed and fitted in the shop to insure perfect fit and alignment in the field. Because of our policy of carrying a large stock of materials at all times, we are in a position to furnish well casing in any quantity on short notice.

Well casing is furnished in any gauge thickness from #16 to #8 gauge inclusive. Double casing is furnished in 24″, 36″ and 48″ loose joints, depending upon the diameter and gauge of material. Unless otherwise specified, an equal number of inside and outside joints are furnished. One inside and one outside joint 24″ long make two feet of double casing. Perforated casing can be supplied on short notice.

It is worthy of note that practically all of the old experienced well



Here is another view of large diameter Western Pipe and Steel Company's well casing in the Salinas Valley, where extensive irrigation operations are the rule.

drilling operators in California insist upon Western Pipe and Steel Company's Hard Red Steel casing. Some of these operators have been using our well casing for upwards of thirty years. In some instances we manufacture casing exclusively for concerns that are important factors in the well business.

(Continued from Page Three)

to the pumps by small units in the wells as at Buena Vista.

The Bascomb avenue station is electrically operated, its capacity being 3,600,000 gallons per day, pumping from deep wells into a storage tank.

The Cottage Grove station is also electrically operated, and has a capacity of 3,300,000 gallons per day, pumping from deep wells into a 42,000-gallon storage tank.

We have been using Western Pipe and Steel Company's well casing for the last ten years or more. The special hard red steel which this company uses in the manufacture of well casing is most satisfactory.

As a part of our operations for the upbuilding of the city and county, we are this year installing a new transmission line and distributing system to serve the East side. This is being done under an agreement with the East Side County Water District, whereby we provide them with water from the San Jose Water Works distributing system. The supply originates primarily in our Ribera pumping plant. The transmission line includes 20,000 feet of 16″ diameter 3/16″ plate welded steel pipe with soil-proof covering, fabricated and installed by Western Pipe and Steel Company of California. This line is laid on Santa Clara street and Alum Rock avenue from Seventeenth street to a reservoir to be constructed on Fleming avenue, south of Alum Rock avenue.

The reservoir on Fleming avenue will be built on a tract of land containing 2.63 acres at an approximate elevation of 210 feet, U. S. G. S. Base, and will have a capacity of 2½ million gallons more or less. It will be constructed by excavation and fill, using excavated material to form compacted banks lined with concrete or other waterproof material, and covered with a wooden roof.

A motor driven pump in duplicate with a capacity of 300 gallons per minute each against a head of 280 feet more or less will be installed on the Fleming avenue property, and pump water to a second reservoir to be located on 2.073 acres of land on Miguelito avenue south of Alum Rock avenue. These pumps will pump water through 6,000 feet more or less of 12″, #10 gauge welded pipe, also supplied by Western Pipe and Steel Company.

The Miguelito Avenue Reservoir will be at an approximate elevation of 470 feet, U. S. G. S. Base; will have a capacity of 1.8 million gallons and will be constructed in the same manner as the Fleming Avenue Reservoir. Two duplicate motor driven pumps with a capacity of 300 gallons per minute each against a head of 300 feet more or less will be located on the Miguelito Reservoir lot, and pump water through 2,200 feet more or less of 10″, #10 gauge welded pipe laid in Alum Rock avenue and through lands of M. C. Brundage, et al., to a steel tank with a capacity of 300,000 gallons on 1.465 acres of land at an approximate elevation of 720 feet adjoining Buena Vista Park.

This 10″ welded pipe and the steel storage tank are also being supplied by Western Pipe and Steel Company. The workmanship and materials, and field installation as well, were found perfectly satisfactory in every way.

A WESTERN PIPE & STEEL PENSTOCK INSTALLED IN IDAHO.—*This line is 90″ diameter, of ¼″ plate, 1127′ long. The head is 80 feet. W. A. Kraner, San Francisco engineer who installed the line for the Clear Lakes Syndicate at Buhl, Idaho, reports that the pipe was installed and tested in 23 days; that but one broken rivet was replaced; and that no caulking was done after water was turned into the line.*

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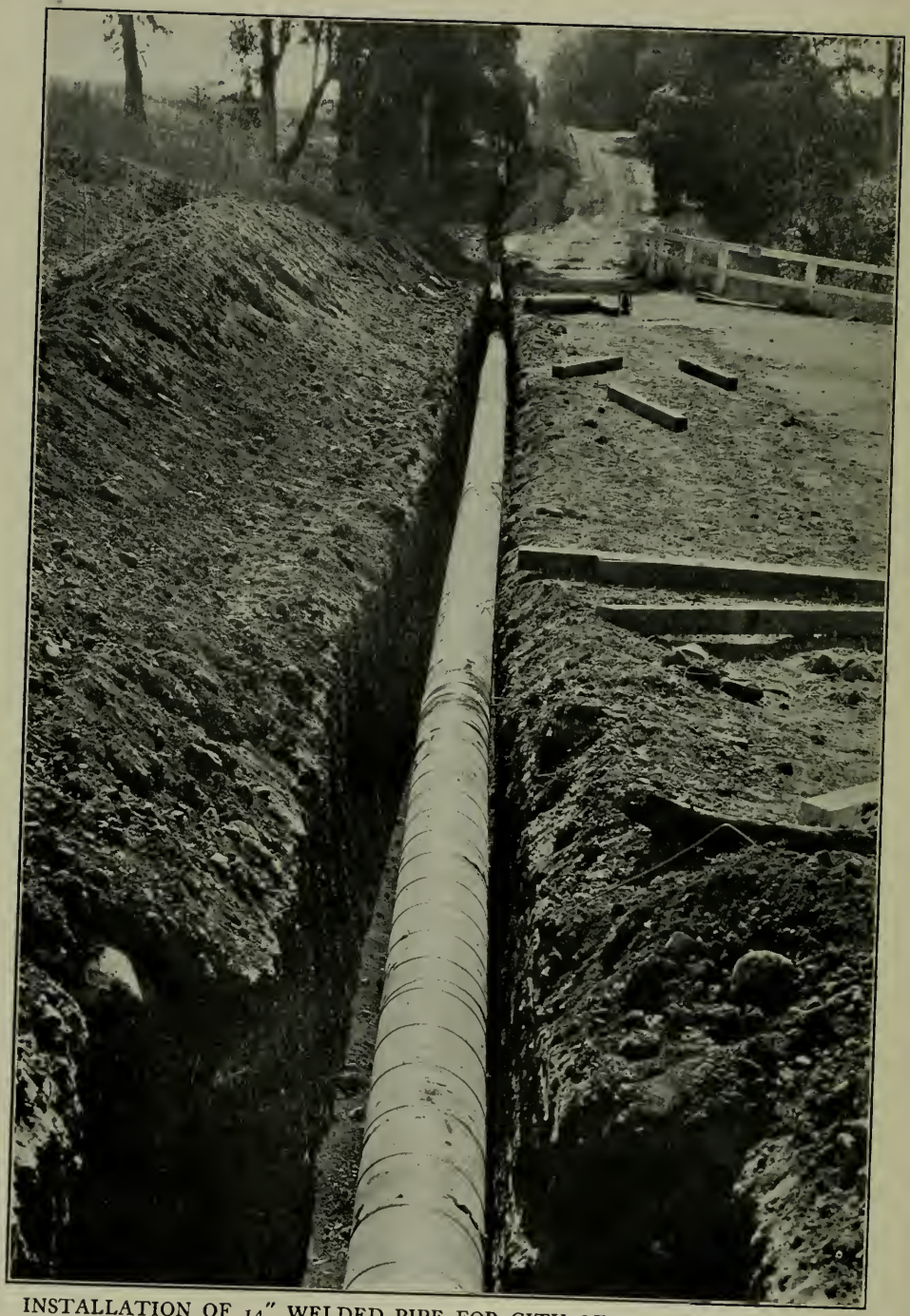

INSTALLATION OF 14" WELDED PIPE FOR CITY OF MONTEREY PARK.—*Western Pipe and Steel Company supplied 9,000 feet of pipe for this new line in Southern California. It was fabricated from 3/16" steel plate, and wrapped with soil-proof covering.*

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VOLUME IV SEPTEMBER, 1927 NUMBER 7

City of Monterey Park Finds Great Saving In Use of Welded Steel Pipe

By O. A. Gierlich,
City Engineer of Monterey Park, California

The City of Monterey Park is located in that fast growing territory known as the "East Side" of the City of Los Angeles and is only five miles from the center of the city.

Within relatively few years the City of Monterey Park has grown from a community of little farms to a thriving up-to-date city of approximately 7,500 population, with a flourishing business district. In 1922 the population was estimated at 3,500, which indicates an increase of over one hundred per cent in the past five years and which places Monterey Park among the fastest growing cities in California. Naturally this rapid growth placed a heavy burden on the municipal water department, keeping up with the enormous growth and rapid increase in demand.

In 1922 the City voted a $225,000 bond issue for the purpose of purchasing the private water system from the company then serving a district including the City, and also to construct a one million gallon reservoir, to replace a portion of the water mains in the built-up sections of the City and to increase the water supply. Water-bearing land at that time was purchased in the San Gabriel basin two miles east of the City. A 10-inch main was installed from this plant to the city's distribution system.

By 1926 this system was out-grown. Additional storage and supply main capacity was required and a second bond issue of $180,000 was voted. A reinforced concrete reservoir of two million gallon capacity is being installed, over twelve miles of distributing mains from four to twelve inches in diameter are being constructed, a new well was drilled at the site of the old plant inside the City, the existing ten-inch main was supplemented by the construction of a fourteen-inch supply main from the San Gabriel plant, and an additional booster pump of 800 G. P. M. was installed.

The major portion of this pipe line is located in extremely hilly section with heavy slopes, the pipe line crossing beneath several creeks which carry a heavy flow of storm waters during the rainy season.

Approximately one-half of the line is under a pumping head of 300 to 375 feet. It was originally planned to construct this line of cast iron pipe. Owing to the extreme heads, the heavier and more expensive classes of pipe would have been required. Alternate

bids were called for on several types and sizes of pipe and the contract was awarded to Western Pipe and Steel Company of California for 3/16-inch welded steel plate pipe with soil proof wrapping.

In comparing the bids it was found that the saving in cost in using this class of pipe permitted an increase in the diameter of the main as originally planned, from twelve-inch to fourteen-inch, with a saving of several thousand dollars from the amount originally set aside for this line.

One of the questions in the writer's mind at the time of contemplating the use of welded steel pipe was the problem of replacing the asphaltic dip coating on the inside of the pipe where same was removed by the field welding.

It was specified that the award of the contract would be subject to demonstrations made in the shop under actual field conditions to satisfy the writer and the water superintendent that this coating could be replaced satisfactorily.

It will be of interest to describe the method that was finally adopted after several spraying devices and types of metal coating had been tried out. Experiments were conducted by the engineers and shop foreman of the Los Angeles plant of the Western Pipe and Steel Company. The one finally adopted was found to replace the inside coating over the

Inspector and foreman inspecting field weld on City of Monterey Park's new 9,000 foot pipe line near Los Angeles.

field welds in a most satisfactory manner as follows:

After experimenting with various paints, a liquid metal paint, with an asphaltic base that flowed freely under pressure and dried quickly, was finally selected. The sprayer consisted of a pressure paint pot under seventy-five pounds air pressure fed through a flexible rubber hose, attached to a half-inch galvanized pipe measured to the length of section. The spray nozzle fastened to the end of the pipe was a circular cap with numerous fine holes drilled in the outer circumference.

The pipe was set on guides which centered the spray nozzle and by drawing same back and forth within the pipe and at the same time revolving the spray, a complete coating of asphaltic paint was placed over the weld. On several occasions a weld located sixty feet from the open end of the pipe was successfully coated.

The pipe was placed across the dry creek beds with a minimum cover of six feet. A concrete jacket ten inches in thickness was placed around the pipe, which was carried up the slopes of the banks to a point well above high-water mark. Air relief valves were placed at points in the line where required and fourteen-inch valves were installed approximately every half-mile.

As one-half of this line was constructed across private property over an easement, in order to provide easy access to the gate valves, standard precast reinforced concrete manholes were placed over the gate valves, with standard manhole covers. The system of installing manholes is also being followed in the distribution system on all gate valves twelve inches or over.

The excavation and backfilling was done under separate contract, the minimum cover over the pipe being three feet in the roadway and four feet along private property. The maximum depth was twelve feet on the bank of the stream and one manhole was installed at this depth.

Rapid progress was made on the work, considering the nature of the terrain in which it was constructed. Approximately twenty-five working days were required to lay the 9,000 feet of line. This is exclusive of delays caused by reason of crossing the stream beds, where ground water was encountered, which required the operation of a trench pump.

THE COVER PICTURE.—*The illustration used on the front cover of this number of* WESTERN PIPE AND STEEL NEWS *tells a characteristic story of the tremendous population growth of Southern California. The picture might have been taken in almost any municipality south of the Tehachipi, large or small.*

The scene depicts the problem with which engineers and municipalities are almost constantly faced, for every addition to population means another consumer of water. The problem of more water is one that brooks no delay in its solution, for without adequate water there can be no growth of population or expansion of industry and agriculture.

The pipeline shown on the cover was installed for the City of Monterey Park, and it is described in detail in the foregoing article by Mr. O. A. Gierlich, C. E.

THIS PANORAMIC VIEW, TAKEN DURING INSTALLATION OF PIPE LINE FOR THE CITY OF MONTEREY PARK, SHOWS GENERAL CHARACTER OF TERRAIN.—*Western Pipe and Steel Company fabricated this pipe at its Los Angeles plant. The line consists of 9,000 feet of*

14" diameter welded steel pipe made from 3/16" plate, and is wrapped with soil-proof covering. In common with most other Southern California municipalities, the City of Monterey Park is experiencing such phenomenal population growth that extensions to the water system are constantly necessary.

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THERE is no more accurate gauge of population growth or of the prosperity of a community or a region than the record of the development of its water supply.

Western Pipe and Steel Company of California again, as it has often done before, takes occasion to call attention to the phenomenal growth and development of Southern California, with particular reference to some of the smaller communities.

Because Western Pipe and Steel Company has been closely connected with the growth of the South for nearly forty years, and because its activities are still interwoven with the development of this land of miracles, we take a special pride in recording, as we do here, some of the recent projects which we have carried out.

Particular attention of our readers is directed to the article in this number of WESTERN PIPE AND STEEL NEWS, written by Mr. O. A. Gierlich, C. E., who describes in detail the pipeline fabricated by this company for the City of Monterey Park. It will be noted from a reading of Mr. Gierlich's article, that he records the same experience many other engineers have had, viz., a very great saving through the use of electric-welded steel pipe under given circumstances, as opposed to conduits of other material. We believe that all thoughtful readers, engineers and laymen alike, will find Mr. Gierlich's article well worth while.

The above picture was taken during the installation of 16" welded steel pipe line for the City of San Bernardino.

Arcadia Installs New Pipe Line

ARCADIA, a residential city about fifteen miles northeast of Los Angeles, is as beautiful as its poetic name would imply. It boasts of two things, besides its lovely shade trees and its charming setting—the fact that every foot of its fifty-four miles of streets is paved; and the purity of its water, which comes entirely from deep wells fed by mountain springs.

The population of Arcadia is well over 6,000. Like so many other Southern Californian cities, it has experienced in late years an increase in population that seems incredible to those not familiar with what is going on in this region.

Arcadia has just completed the installation of a 15,000 foot transmission line, to bring water from a 26" well, 550 feet deep, to a reservoir situated in the northern part of the city, and from which point water is distributed to the lower portions of the city.

This line, which was fabricated at the Los Angeles plant of Western Pipe and Steel Company, is 20" diameter, No. 10 gauge steel, double dipped, and wrapped with soil-proof covering, and with driven joints. The static head is ninety-five feet, and the capacity of the line is 3,500 G. P. M.

G. B. Watson is engineer in charge of the Engineering and Street Department of the City of Arcadia, and M. Lee Scott, Jr., is superintendent of the Water Department. Mr. Scott was in direct charge of the installation, which is illustrated below.

Field crew installing 20" steel water pipe for the City of Arcadia, fabricated by Western Pipe and Steel Company.

Western Pipe and Steel Company furnished 15,000 feet of pipe, illustrated above, for the City of Arcadia. It is 20" in diameter, made of No. 10 gauge steel, and is covered with soil-proof wrapping.

CITY OF ARCADIA INSTALLS 15,000 FEET OF WESTERN PIPE AND STEEL 20" WELDED STEEL PIPE.—*This line, which was double dipped and wrapped with soil-proof covering, serves to bring water from a 26" well to a reservoir in the northern part of the city, whence the water is distributed.*

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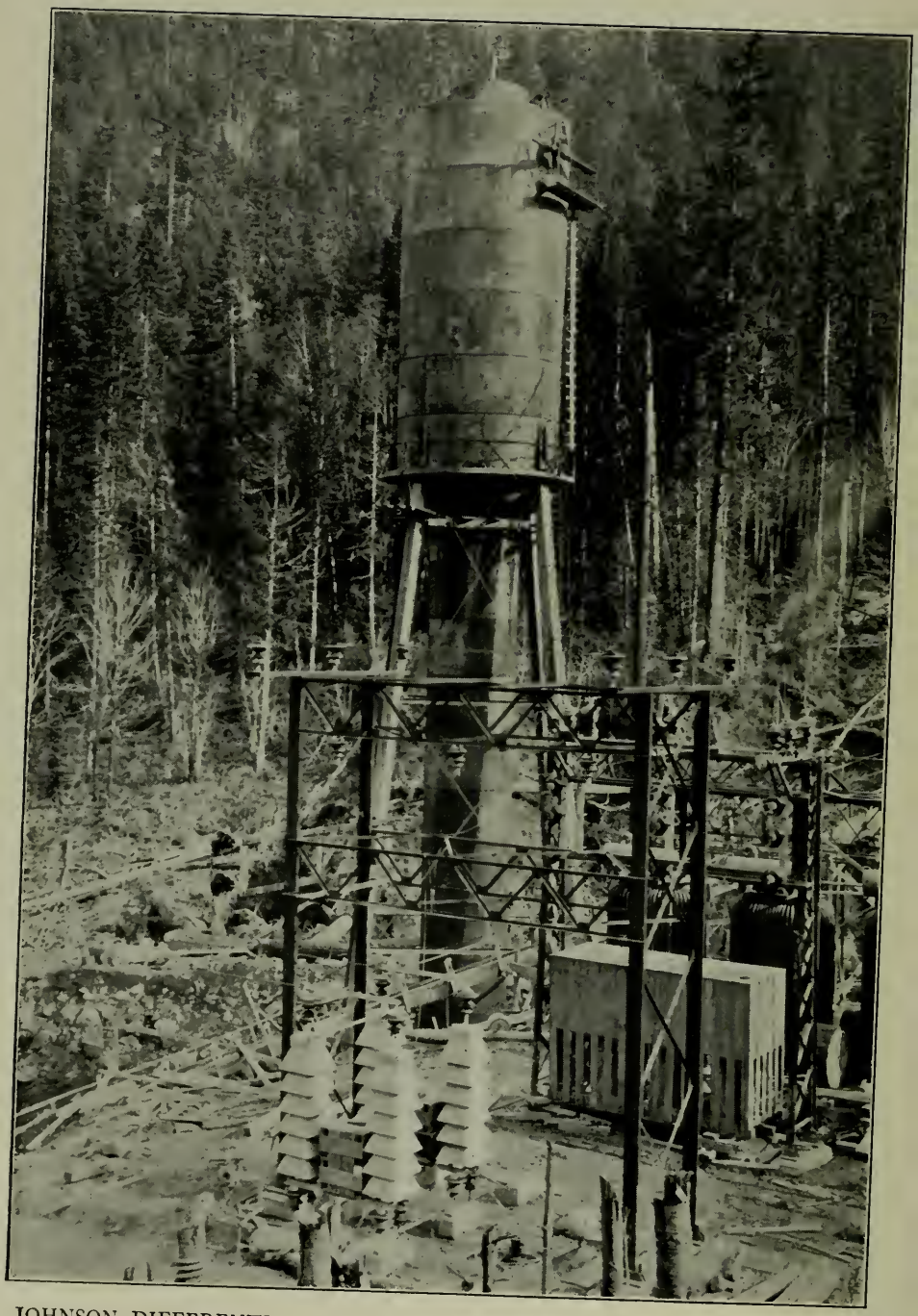

JOHNSON DIFFERENTIAL SURGE TANK FOR NORTHWESTERN POWER & LIGHT CO.—*This picture and the front cover picture were taken at the Glines Canyon development near Port Angeles, Washington. The tank proper is 20′ in diameter and 51′ 6″ high. The tower is 88′ 4″ in height. Work fabricated at Western Pipe and Steel Company's South San Francisco plant.*

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The Glines Canyon Development of the Northwestern Power & Light Co.

By W. B. McMillan, Construction Engineer
Thebo, Starr & Anderton, Inc.

The Glines Canyon development of the Northwestern Power & Light Co., which supplements its Elwha power station, was necessitated by the adoption early last year of plans by the Washington Pulp & Paper Co. by which its plant at Port Angeles, Washington, would be nearly doubled in capacity by additions and extensions. The Glines Canyon development is situated on the Elwha river 7½ miles upstream from the first plant, and about 15 miles southwest of Port Angeles. The plant develops 13,333 kva, or 20,000 horsepower.

The installation at the new Glines plant is the largest automatically equipped single unit water wheel generator so far constructed, and is operated by remote control from the Elwha plant. The energy from both plants is used almost entirely by the Washington Pulp & Paper Co. in its paper manufacturing operations. This requires a close degree of speed regulation, which is obtained through a generator of heavy flywheel effect, and a specially designed surge tank and penstock.

The project, which was designed and constructed by Thebo, Starr & Anderton, Inc., San Francisco engineers, includes a high dam, pressure conduit, and power-house.

The Glines Canyon dam is a concrete arch 200′ high, situated in a narrow gorge 55′ wide at the bottom. Its upstream radius varies from 62′ at the base to 128′ at the crest. The virtual base thickness is 28′ with a flat apron 25′ above. The crest is 4′ wide, and is surmounted by a walkway 10′ higher. The crest length of the dam proper, between the gravity abutment block on the east end and the spillway on the opposite end is 152′. The spillway section is 121′ long to provide for five Tainter radial gates 18′ by 20′, fabricated by Western Pipe and Steel Company of California at its South San Francisco plant for the Joshua Hendy Iron Works, with whom the order was placed.

On page three of this number of Western Pipe and Steel News will be found two interesting pictures of these Tainter gates. One shows gates being assembled at Western Pipe and Steel Company's plant, while the other shows them installed at the dam.

The reservoir formed by the Glines Canyon dam has an area of 380 acres, with a storage capacity of 43,000 acre feet, of which 27,000 acre feet will be used for the generation of power. The maximum drawdown during low flow periods will be 57′ below the flow line, at elevation 607′,

giving a mean operating head of 188′.

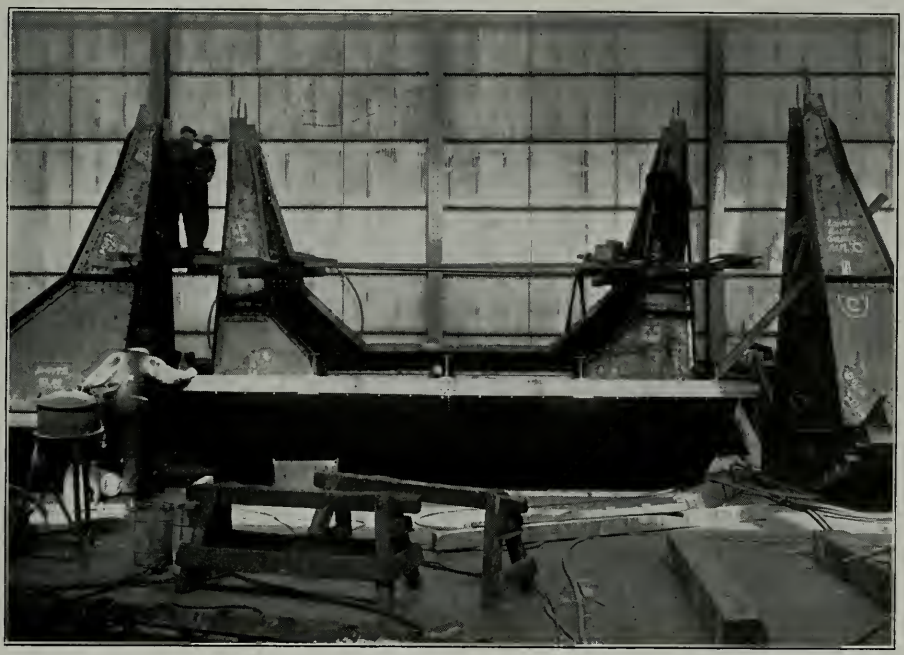
The center of inlet of the pressure power tunnel is at elevation 527′, or 83′ below the crest of the dam. The inlet is provided with a trash rack and rake, the rack being 20′ by 40′ with ⅜″ by 4″ steel bars spaced on 3″ centers, and extension bars ¼″ by 3″ on 3″ centers carried 75′ up to the platform of the operating tower, as a guide for the rake. The operating platform is at elevation 619.5′, beneath which is a trash bunker.

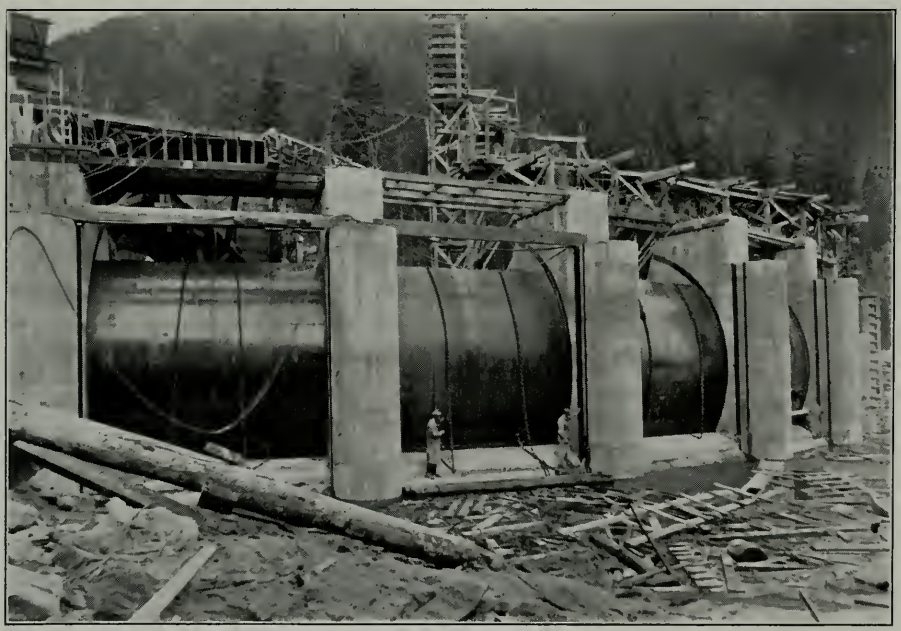
The power tunnel, 569′ long and under a pressure head of 80′ to 108′, is driven through solid diabase and is gunite lined; the finished dimensions being 14′ wide and 9′ high to spring line of arch, which has a 4′ rise additional. At a point 190′ from the trash rack there is a control gate shaft through which is operated a 7′ by 12′ Broome Caterpillar type gate. The tunnel is plugged, 157′ beyond the control gate, to a 10′ diameter steel pressure pipe, 321′ long, which connects with a surge tank of the Johnson differential type.

The surge tank proper is 20′ in diameter by 51′ 6″ high, with a 9′ diameter interior riser. It is supported by four structural steel-laced channel columns, forming a tower 88′ 4″ high. The outside riser pipe from the penstock to the bottom of the surge tank is 11′ in diameter. The total height of the tank structure from the eaves of the roof to the footings, which are 5′ below the center line of the penstock (at elevation 491′), is 140′.

The penstock from the surge tank to the turbine in the power house, is a steel pipe, 11½′ in diameter, and 158.7′ long, with a taper connection to an 8′ 6″ diameter butterfly valve at the inlet to the turbine casing. The total length of pressure tunnel and penstock is 857′. The surge tank, tower, and riser pipe were fabricated and erected by Western Pipe and Steel Company of California.

View of Glines Canyon dam spillway showing five Tainter radial gates fabricated by Western Pipe and Steel Company.





Upper view, taken at our South San Francisco plant, shows shop assembly of Tainter radial gates for Glines Canyon development, Northwestern Power & Light Co. Lower view shows installation of gates.

GROUP OF DELEGATES, EXHIBITORS AND GUESTS AT THE SAN J

ONVENTION, CALIFORNIA SECTION, AMERICAN WATER WORKS ASSOCIATION.

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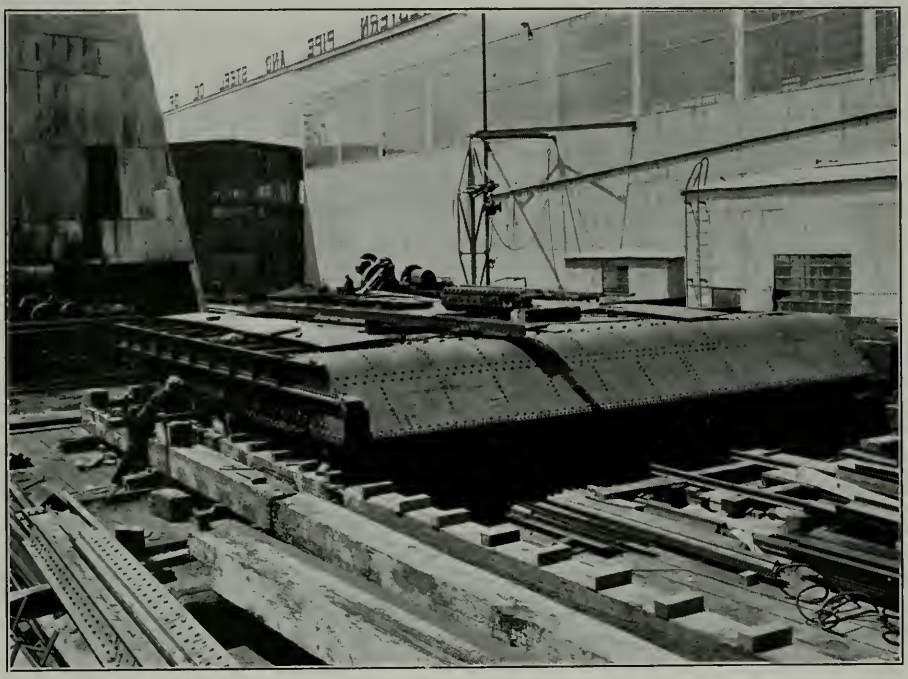
THE growing importance of organizations such as the American Water Works Association, was strongly attested at the annual convention of the California Section at San Jose, October 5 to 8.

In point of attendance, the San Jose convention established a new record with a total registration of five hundred and sixty-four. This is nearly two hundred more than attended last year's convention at San Diego, and this difference may be said fairly to represent a year's growth in interest in the proceedings of the association.

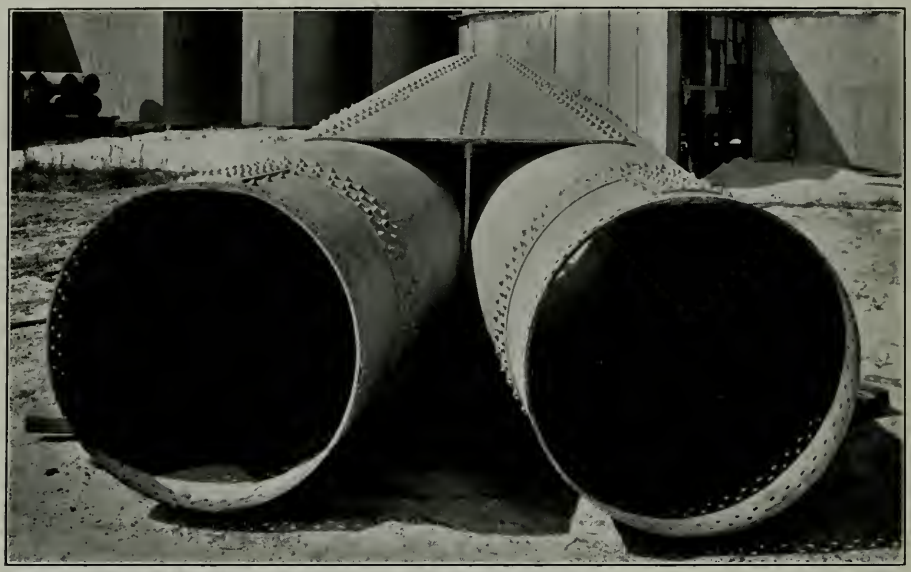
A striking feature was the exhibits, which were the most extensive and elaborate in the history of these conventions. This company was one of the fifty-one manufacturers represented. Our display included samples of lock-bar, riveted, and welded steel pipe, well casing, galvanized corrugated culvert pipe, fittings, models of various types of steel tanks, and a display of some two hundred photographs of products.

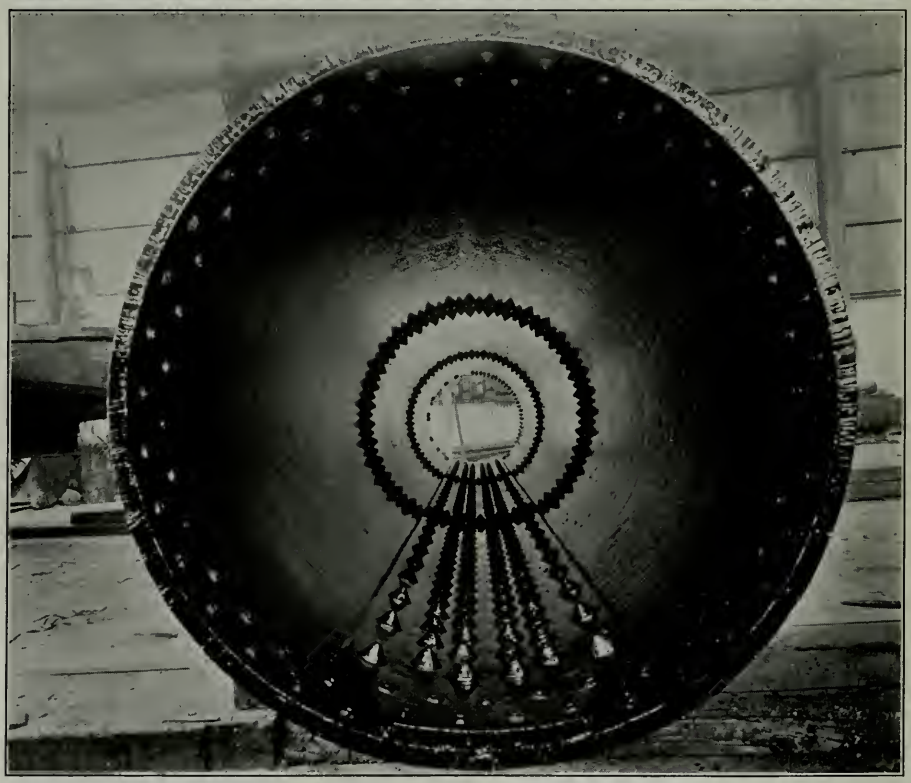
The following officers were elected: chairman, Joseph R. Ryland, president of the San Jose Water Works; vice-chairman, John Burt, manager, Marin Municipal Water District; executive committee, Charles S. Olmstead, superintendent, Monterey Water Works, and W. F. Goble, of Alhambra; secretary-treasurer, William W. Hurlburt, office-engineer, Bureau of Water Works and Supply, Los Angeles.

Western Pipe and Steel Company fabricated and installed this battery of storage tanks for the Barrett Co., South San Francisco. The tanks are 10′ 6″ in diameter by 32′ in length. The structural steel work also was fabricated and installed by this company.



Top view shows assembly of roller spillway gates 30′ by 30′ for Stony Gorge project, Orland, Calif. These gates weigh nearly seventy tons each. Below, double jacketed steam kettles fabricated for Morrill Ink Co., South San Francisco.





TOP—*80" Y-branch designed and fabricated by Western Pipe and Steel Company for Feather River Power Co., Bucks Creek project. Diameter of branches is 54".* BELOW—*Section of penstock 42" in diameter made of 1¼" steel plate for Feather River Power Co.*

LOCK-BAR STEEL PIPE, ROCKRIDGE SYPHON, EAST BAY MUNICIPAL UTILITIES DISTRICT.—*This interesting view taken just below line of San Francisco and Sacramento railway in Rockridge Canyon, shows double line of lock-bar syphon. The pipe was fabricated at Western Pipe and Steel Company's South San Francisco plant.*

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INSTALLATION AT INTAKE END OF MONO-BEAR CREEK SIPHON, SOUTHERN CALIFORNIA EDISON COMPANY.—*The waters diverted by tunnels from Mono and Bear Creeks are brought to a junction just above this point. The invert of the siphon, at the crossing of the South Fork of the San Joaquin River, is 700′ lower in elevation than the intake.*

SPECIAL COLLECTIONS

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Mono-Bear Creek Siphon of the Big Creek Hydro-Electric Project of Southern California Edison Company

By E. R. Davis, Manager of Construction
Southern California Edison Company

Readers of Western Pipe and Steel News are in general familiar with the Southern California Edison Company's Hydro-Electric development known as the "Big Creek-San Joaquin Hydro-Electric Project," construction work on which was started about sixteen years ago and has been in continual progress, except for a two-year period (1918-1919) during which time its construction forces were engaged in the building of its Kern River No. 3 Hydro-Electric plant on the Kern River.

Its readers, no doubt, do not realize that this mammoth Hydro-Electric development, coupled with its modern and major steam-electric plant installation at Long Beach, placed the Southern California Edison Company in the position in 1926 as fourth largest distributor of electrical energy in the United States. It has been estimated that the ultimate cost of the Big Creek-San Joaquin Project, with the necessary transmission lines and substations, will exceed $375,000,000.00. During the past six years construction expenditures at Big Creek alone have averaged better than three-quarters of a million dollars a month.

Government records indicate that the average annual run off of the San Joaquin River exceeds 2,000,000 acre feet. This water yield is derived from some 1631 square miles of drainage area above the Government gaging station located at Friant, where the river emerges from the mountains and begins its journey through the San Joaquin Valley to the sea. In 1924 (California's recent dry year) the total capacity in storage reservoirs on the San Joaquin River and its tributaries was 135,000 acre feet, or approximately 6¾% of the annual yield of this large drainage area.

The company's development has been divided into two divisions known as the East Side and West Side respectively. The East Side development is located almost exclusively within the mountain territory of Fresno County, while the West Side is practically all within the mountain area of Madera County.

Three of the four large Hydro-Electric plants of the company now in operation are located along the banks of Big Creek and secure water from the drainage area tributary to Big Creek, Stevenson Creek and the South Fork of the San Joaquin River, and the fourth plant, known as "Big Creek No. 3," uses the water from the other three stations and also uses water flowing in the main river above the junction of Big Creek.

The initial installations in Big Creek Power Houses No. 1 and No. 2,

together with the 90,000 acre foot reservoir known as "Huntington Lake," were made prior to 1918. Since the drainage area tributary to these two plants did not yield sufficient water for their full development, the company began the construction of the 13½ mile Florence tunnel in 1920 and completed this famous tunnel early in the year 1925.

In 1924 the company began the construction of a large multiple arch dam across the South Fork of the San Joaquin River just below the intake of the Florence tunnel. This dam was completed in the fall of 1926 and serves the double purpose of directing the flow of the South Fork through this tunnel to Huntington Lake and also creates a new reservoir of 64,000 acre feet capacity, known as Florence Lake reservoir, and which permits of securing efficient regulation of high flow of the South Fork during the period of late spring and early summer, when the vast quantities of snow deposited on the high mountains surrounding its drainage area are melting.

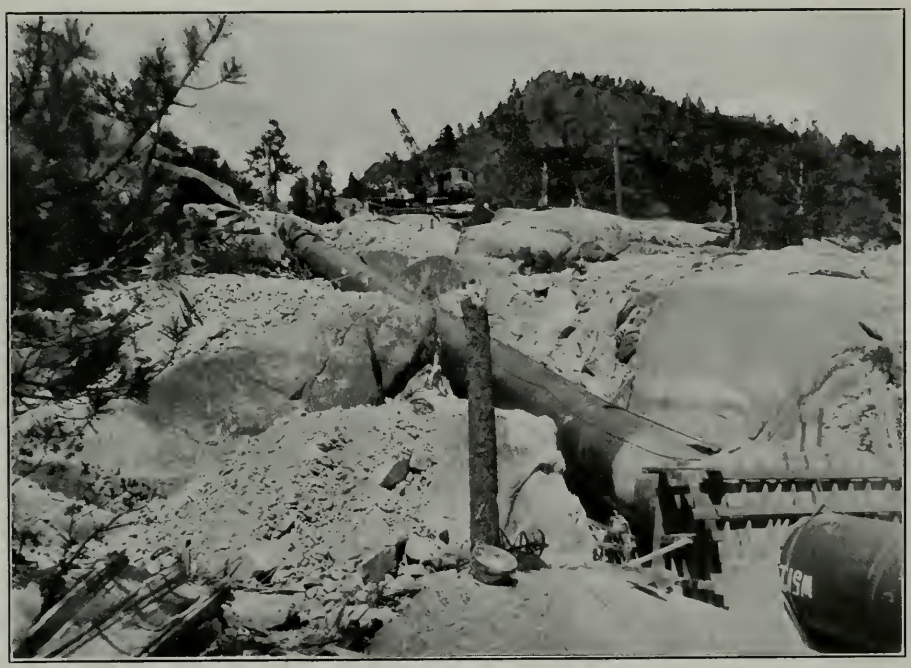
In 1925 the company began the construction of a 13 foot diameter tunnel between Huntington Lake and its third and largest reservoir site at Shaver Lake, and also began the construction of this reservoir in that year. The large gravity dam constructed at Shaver for this purpose was completed in November of this year and creates a reservoir of 138,-500 acre feet. The tunnel between Huntington and Shaver Reservoirs will be completed by the end of December of this year.

From the above description it will be seen that we have three large storage reservoirs connected together by two large capacity tunnels. The floors of these reservoirs are at

An excellent illustration of the rugged character of the country traversed by the Mono-Bear Siphon of the Southern California Edison Company, described in Mr. Davis's article. In the distance is seen Bear Ridge.

approximate elevation of 7200 feet, 6800 feet and 5200 feet above sea level for Florence, Huntington and Shaver respectively. The drainage areas directly tributary to these three reservoirs approximate 300 square miles. The water yield from this area should average between 450,000 and 500,000 acre feet per year. To the north of the Florence tunnel and reservoir are located two very large tributaries of the South Fork of the river known as Bear Creek and Mono Creek respectively. The junction of these streams with the main river is several miles down stream from the Florence reservoir and separated from the Florence tunnel by the wide and deep canyon of the South Fork. The drainage area tributary to Mono and Bear Creeks is approximately 145 square miles. The early preliminary plans of the company contemplated the diversion of these streams to Florence Lake through a system of tunnels more than eight miles in length and through very rugged territory. As our studies progressed it became apparent to the engineers that if these streams could be harnessed and the water delivered directly to the Florence tunnel at a point about four miles from Florence Lake, it would save at least a year in time and more than a million dollars in cost of construction. The earlier date that these diversions could be completed was a very important factor, since it would permit of using this water through the latest and highest head plant of the Big Creek-San Joaquin Project now under construction and which will be completed on June 1, 1928.

The plan to divert Mono and Bear Creeks directly to the Florence tunnel, was approved in the Spring of



Looking up to Bear Ridge where the diverted waters of Mono and Bear Creeks are brought together at the intake of the siphon. Pipe fabricated at Western Pipe and Steel Company's Los Angeles plant.

1926. This plan involved some very interesting and difficult engineering and construction problems. Mono and Bear Creeks flow in the general direction from Northeast to Southwest from their source to the junction of these streams with the South Fork. The streams are parallel and about two miles apart and are separated by a high rocky ridge, known as "Bear Ridge," rising nearly two thousand feet above the floor of the stream beds. The elevation of the Florence tunnel at the point where Mono and Bear Creek water was to be delivered was 7140 feet above sea level. Engineering investigations indicated that elevation of the diversions on Mono and Bear Creeks should be about 200 feet higher than the connection with Florence tunnel. A concrete diversion dam was constructed on each of these streams, with a spillway crest at 7350 feet above sea level. The plan involved bringing the waters diverted from these streams to a junction on the Southeast slope of Bear Ridge at a point nearly 700 feet in elevation above the waters flowing in the South Fork of the San Joaquin and required the construction of a steel pipe siphon from this point across the river gorge to the Florence tunnel.

On account of the barren granite mountain slopes and the heavy snows, a combination particularly inviting for snow slides and low temperatures experienced at this altitude, it had been determined to place the pipe for its entire length in a trench, which would be thoroughly drained under the pipe, and to backfill the trench after the pipe was laid.

Due to the impracticability of carrying on work of this nature at this altitude during the winter months, and its inaccessibility before May or June of any year, it was

At the left is a glimpse of one of the Edison Company's many construction camps, and to the right of the pipe line may be seen a construction road. The pipe was trucked from the railhead at Huntington Lake, over twenty miles away.

necessary to complete the installation of the siphon before November 15th of this year. This called for the most careful planning and carrying through of the plan adopted.

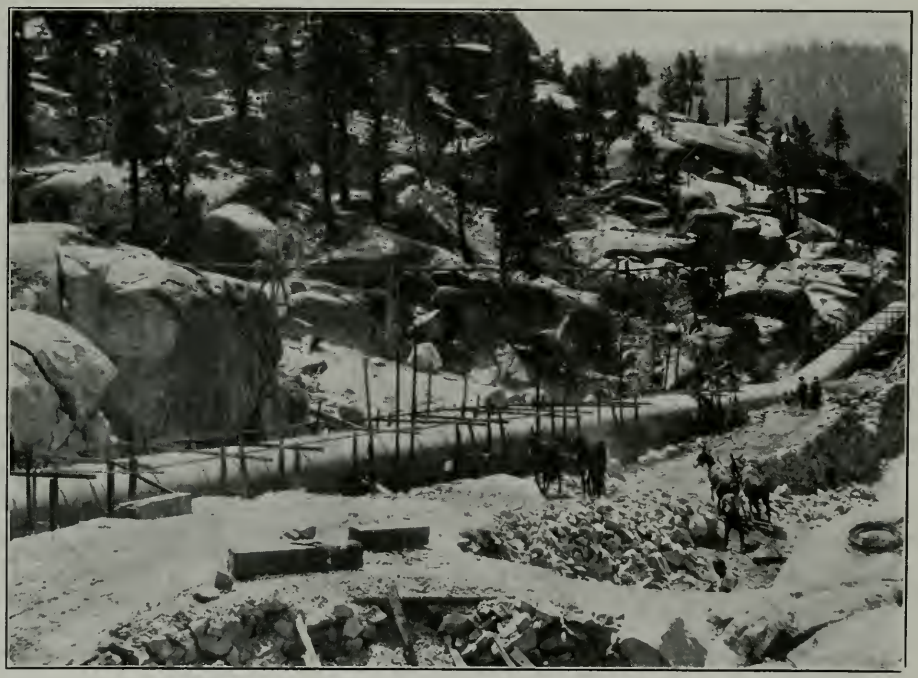
This siphon contains approximately 5500 tons of steel and is 13,806 feet in length, measured along the center line of the pipe, and varies from 72″ to 102″ in diameter and ⅜″ to 1″ in thickness. It has a maximum static head of 775 feet. The theoretical discharge capacity of the pipe is 600 second feet.

72″ and 84″ diameter pipes are concreted into the outlet end of the Bear and Mono tunnels, which are 7,589 feet and 3,933 feet in length respectively. These pipes run approximately 125 feet back into the tunnel. At a point 40 feet outside of the tunnel they are connected together by means of a 7′ x 7′ x 8′ 6″ wye lateral, each leg forming an angle of 37½° with the center line of the base. A 10″ Coffin air valve is connected to the top of the siphon pipe near each end. A 102″ Butterfly valve which is operated either by gas engine or hand, is located near the discharge and where the siphon is connected into the Florence tunnel. This valve has a 10″ by-pass valve for regulating the filling of the siphon from the tunnel should this be necessary.

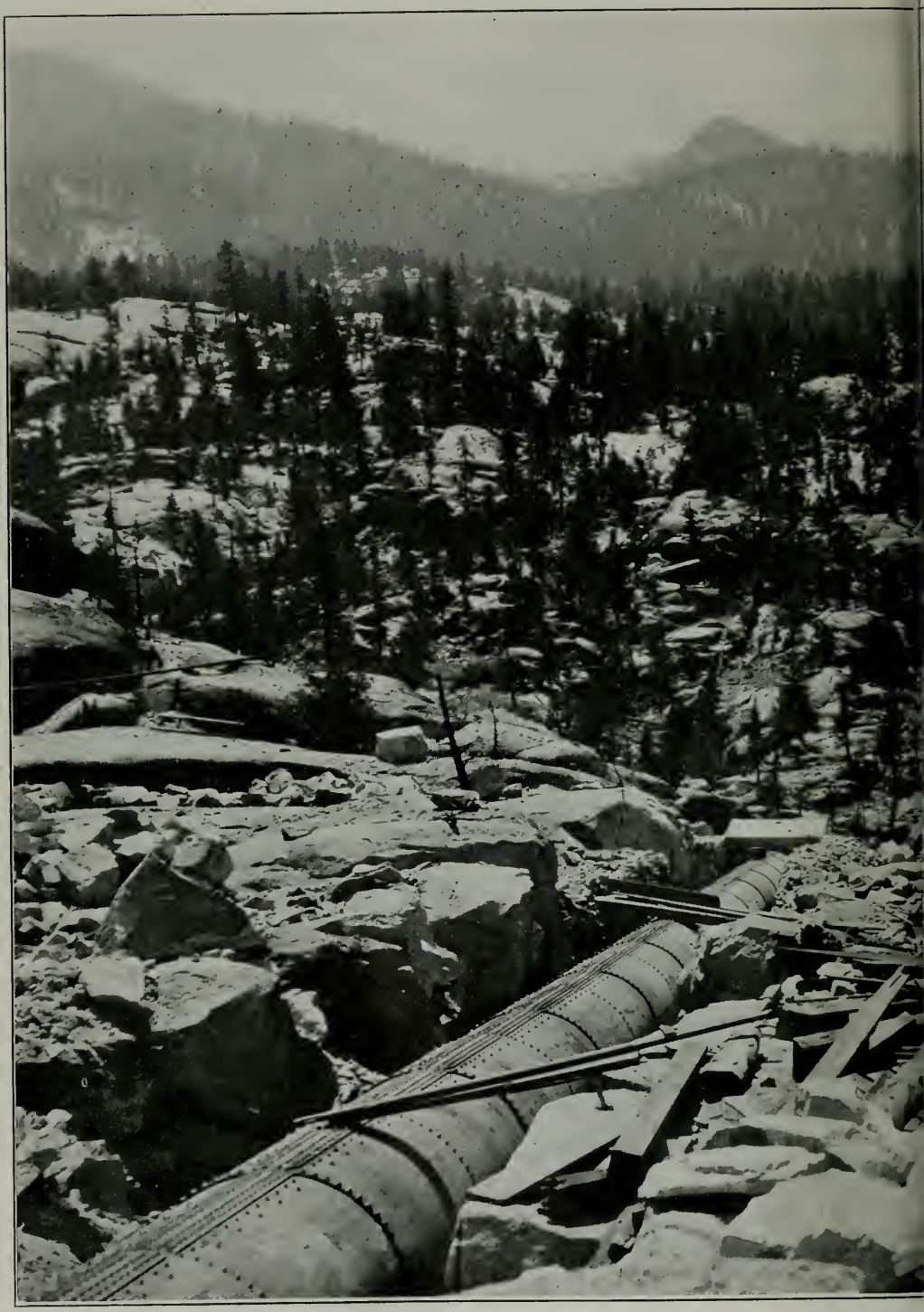
A 10″ gate valve and 10″ needle blow-off valve with concrete and steel deflector for draining the siphon is located in the invert of the siphon directly over the channel of the San Joaquin River.

The river crossing span is 79′ 7″ between centers of concrete piers. As back filling is impractical at this point for a distance of approximately

Continued on Page Nine



As shown by the illustration, the country traversed by the Mono-Bear Creek siphon is badly broken up, and consists of a series of almost barren gray granite ridges through virgin territory.



SPANNING THE WIDE CANYON OF THE SOUTH FORK OF THE SAN JOAQUIN RIVER, THE MONO-BEAR SIPHON OF THE SOUTHERN CALIFORNIA EDISON COMPANY IS 13,806′ IN LENGTH.—*The rugged nature of this High Sierra country is well illustrated in the above picture. When it is borne in mind that this huge pipe was laid in trenches blasted out of solid granite for almost the entire distance, and that it was back-filled to a depth of four feet, minimum covering, the engineering problems involved take on a most impressive magni-*

ude. The siphon contains approximately 5,500 tons of steel and varies from 72" to 102" in iameter, and from 3/8" to 1" in thickness of plate. The maximum static head is 775' and the heoretical discharge capacity of the pipe is 600 second feet. There is a difference of 700' in levation between the intake of the siphon and the invert over the channel of the South Fork of he San Joaquin River. The pipe shown was fabricated at the Los Angeles plant of Western Pipe nd Steel Company of California.

Western Pipe and Steel News

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EDITED BY RICHARD PROSSER

THIS number marks the close of the fourth year of the career of WESTERN PIPE AND STEEL NEWS. From the time the magazine was established, early in 1924, its avowed purpose has been to broadcast interesting and helpful information regarding projects great and small with which we have been connected, and to record the progress and development of our manufacturing facilities and service.

It has been our privilege to present to our readers a wide range of interesting subjects, but it is doubtful if any issue has been more distinctive than this. We take a very special pride in being the first to publish Mr. Davis's article on the Mono-Bear Creek Diversion. Other editors are hereby given permission to reprint any part of this issue, with due credit to WESTERN PIPE AND STEEL NEWS.

The Big Creek-San Joaquin Hydro-Electric project, of which the Mono-Bear Diversion is but one phase, is one of the greatest—if not the greatest — engineering projects in history. Its total ultimate cost is estimated at more than $375,000,000, a sum exceeding the cost of the Panama Canal by nearly $25,000,000. It is an experience of a life-time to view a project of such magnitude.

A few months ago Mr. Davis, who has been engaged on this work in the High Sierras almost continuously for the last sixteen years, personally conducted over the project a party of which the editor was privileged to be one. It was agreed that this was the most interesting and instructive trip ever experienced by any present.

Pipe for the Mono-Bear siphon was fabricated at Western Pipe and Steel Company's Los Angeles plant in 17.25' lengths, for economical handling. This picture shows special cradles built on trucks for hauling over steep mountain grades.

Continued from Page Five

200 feet the pipe is covered in this section with a laminated lagging of alternate layers of lumber and tarred building paper; the outside layer of lumber is covered with two layers of three-ply roofing felt which has been given two coats of the material with which roofing felt is impregnated.

There are 33 plate and structural steel built-up expansion joints in the line. These vary from 72″ to 102″ in diameter, one is located between each two concrete anchors; the anchors are located at each horizontal and vertical line and grade change. The expansion joints are protected by concrete housing.

While the line is graded to meet the changes in slope of the mountain, as nearly as practical, there are places where economics dictated that the pipe be supported on piers. A study of the cost of these in place developed the fact that a structural steel pier fabricated, assembled and galvanized in the shop would be the cheaper for certain heights and locations and a concrete pier in others; therefore, both types were used.

In the excavation of the trench several free-flowing springs were encountered and these were drained to points outside the trench and beyond the backfill.

The blocking used in the assembling of the pipe was removed after the riveting, welding and caulking and partial backfilling had been completed, and before the line was backfilled, in order to permit of continuous bearing throughout the length of the pipe, this being one of the assumptions in the design.

As shown by the illustrations, the country traversed by the siphon is badly broken up and consists of a series of almost barren gray granite ridges through virgin territory, and which, save for a government trail was entirely inaccessible.

The outlet connection at the Florence tunnel or south end of the siphon, at an elevation of 7,140 feet above sea level, is on the road between Huntington and Florence Lakes, which was constructed by the Edison Company at the time this tunnel was built, but from this point it was necessary to build roads and camps, also power and telephone lines, before the actual work on the siphon could commence. This work was started in July, 1926, and before the first heavy snowstorm of the season which came on November 15th, closing the job until May 15th, 1927, there had been nine camps established with their power and telephone connections.

By November 15th, 1926, 4,137 feet of trench had been excavated representing the removal of 22,000 cubic yards of material of the total of 62,300 cubic yards required. The trench was excavated 48 inches wider than the diameter of the pipe at any particular point and one foot below the finished grade of the pipe.

The plan and profile of the pipe was designed to meet the rough and broken up ground surface to the best advantage with due consideration to the backfill requirements. Between the rock ridges the pipe in places is practically laid on the surface of the ground, and here rough rock walls from material secured from the excavation are laid up to keep the yardage of backfill at a minimum.

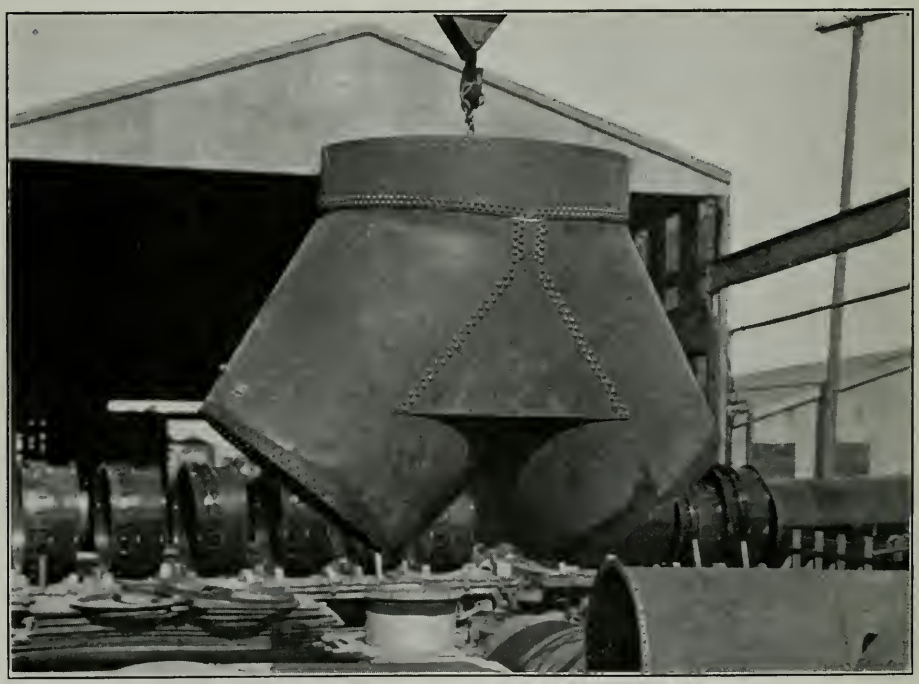
The pipe was fabricated during the fall of 1926 and the first four months of 1927. It was delivered to a storage yard at Auberry, a division point on the San Joaquin & Eastern Railroad, which is a subsidiary utility built and operated by the Southern California Edison Company in connection with the Big Creek-San Joaquin River development. The pipe was given two shop coats of red lead and

oil mixed according to the company's specifications, and given a third or final coat of red lead and oil in the trench after the riveting, etc., had been completed.

The distance by road from Huntington Lake to the outlet of the siphon is 21 miles and all material and supplies for this work were hauled from the rail head at Huntington Lake to the site by truck. This road crosses Kaiser Pass at an elevation of 9,300 feet above sea level, and on June 1st, 1927, as soon as snow conditions on this section of the road would permit, the delivery of the pipe to the siphon site was commenced.

Where excavation had been completed the pipe was delivered direct to the trench without rehandling, but inasmuch as a fleet of 12 trucks of from five to ten-ton capacity were hauling the pipe from the railroad, truck breakdowns and the human factor had to be given due weight, and a pipe yard was established at the outlet of the siphon where sufficient pipe was stored to guarantee against time lost in erection from any cause.

The pipe was fabricated in 17.25′ lengths, which was the length that the equipment available would handle most economically, and a special cradle was built on the truck chassis for delivery over the steep mountain grades. The cradle as designed worked out very satisfactorily. The pipe was transferred from the trucks to the trench by means of gas shovels rigged as cranes. These had previously operated on the de-



The outlet pipes from Bear and Mono tunnels are brought together by this 7′ x 7′ x 8′ 6″ Wye, connecting up with the siphon proper. Photo taken at Los Angeles.

velopment as shovels and were available for this work.

The main road built for construction, which so far as is feasible parallels the pipe line, will be maintained for the operation and servicing of the line. Some branch roads were built to serve sections which were inaccessible from the main road.

The first piece of pipe was placed in the trench on May 15th, 1927, and with the exception of the few joints which were concreted into the Mono and Bear tunnel outlet portals, the placing was completed by September 30th of this year.

The pipe was placed in the trench, pinned and bolted up by company forces on the regular daily schedule rates, as excavation, concreting, and pipe delivery to the trench were controlling factors which limited production. However, the riveting crews, each of which consisted of four men, namely, riveter, holder-on, passer and rivet-heater, were especially picked men and worked on a piece-work basis. Previous investigation had proven this to be an advantageous plan both for the skilled mechanic and for the company, insofar as quality of work and necessary progress was concerned. The maximum number of sections of pipe laid in the trench per crew in one working day was eleven; the maximum number of ⅞″ rivets driven per crew per shift was 1,072; and 517 rivets of 1¼″ diameter per crew per shift. Three four-man riveting crews were engaged on this work.

All placing, riveting and caulking crews were under the supervision of an experienced erection engineer, and piece-work rivets were checked, and approved by his inspector before acceptance. The system proved very successful on this work.

After the final coat of red lead had been applied to the pipe in place, the pipe was backfilled for 45 degrees on either side of the vertical center line between the blocking which was then removed. This fill was carefully placed to avoid scarring the paint. The siphon was filled with water and the leaks caulked. After this test the pipe was entirely backfilled with a minimum thickness of 4′ over the top of the pipe, which it is believed will keep the water in the siphon from freezing during the period of low winter temperatures, at which time the amount of water entering the pipe from the stream is very small, but quite valuable, as every second foot passes through four power houses with a combined drop of 5,538 feet, and a potential generating capacity of 8,500 K.W.H. per second feet. A total of 75,720 cubic yards of backfill was placed; this material was secured from the Florence tunnel dump and a glacial deposit of granite sand found near the intake end of the siphon.

In order to secure firsthand information for future operation of this siphon, six recording thermometers have been installed at control points of the diversion both in the tunnels and in the siphon line. During four or five winter months this siphon is entirely isolated from other parts of the Big Creek development, and two crews of two men each are detailed to stay on this work during the coming winter to read the thermometers and watch conditions generally. Telephone or radio reports are to be made by these men to the headquarters camp periodically.

A large portion of the pipe in the siphon was purchased from the Western Pipe and Steel Company, and valuable information was given by them in connection with the planning and rating of the piece-work riveting crews, most of whom were recommended and furnished by them.

In some places it was necessary to lay the pipe on the surface of the ground, and the problem of covering it was solved by laying up rough rock walls as shown above, to keep the yardage of back-fill at a minimum. The pipe was finally covered to a depth of four feet as a protection against snow slides and low temperatures.

OUTLET CONNECTION OF MONO-BEAR SIPHON AT FLORENCE TUNNEL.—*This point is at elevation 7,140′, and about 200′ lower than the diversions of Mono and Bear Creeks. The pipe is 102″ in diameter. The pipe here enters one of the adits of the famous Florence tunnel.*

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WESTERN PIPE AND STEEL NEWS

INSTALLATION OF NEW PIPE LINE FOR CITY OF SACRAMENTO.—*Illustration above shows 42" diameter steel pipe under installation at city filtration plant on the Sacramento River.*

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A New Lock-Bar Steel Pipe Water Main for the City of Sacramento

By ALLAN J. WAGNER, City Engineer

ON ACCOUNT of the rapid increase in the population of the City of Sacramento, and consequent increase in water consumption, it was found necessary to plan additions and extensions to the City's existing water system to properly take care of the situation.

In 1926, a bond issue of $350,000, to be used for enlargement of the filtration plant, and $550,000 for extension of the distribution system, was voted by the people, and the work was started in the early part of 1927.

Our water supply is taken from the Sacramento River at a point near the extreme northwesterly corner of the City. The water is settled and filtered by means of a modern filtration plant, and then pumped into the mains for use. A pressure of sixty pounds per square inch is maintained at the plant, but during the hours of greatest demand this pressure is very hard to maintain. At locations remote from the plant, the pressure drops down sometimes as low as thirty pounds, due, of course, to the heavy consumption and the fact that the mains leaving the plant were not of sufficient size to furnish the required quantity of water.

Sacramento consumes a very large quantity of water, the average per capita being about 300 gallons daily. This heavy consumption is accounted for by our extensive lawns and the large number of trees, all requiring irrigation during the dry season.

The newer portions of the City suffered most from the lack of water and low pressures, due, of course, to insufficient water mains.

In connection with our new water system, we are doubling the capacity of the filtration plant in order to furnish more water. To distribute this additional water, a new main was required, one of large capacity extending from the filtration plant to the eastern part of the City where the shortage of water is felt the most.

In May, 1927, bids were asked for this new main, comprising the construction of 8,700 feet of lock-bar or riveted steel line, together with necessary wyes, elbows, valves, manholes, etc., and on May 19, 1927, the contract was awarded to the Western Pipe and Steel Company of California, they being the low bidders.

Under the contract the work in general consisted of the fabrication and installation of approximately 2,500 feet of 42-inch; 2,400 feet of 40-inch; 1,680 feet of 38-inch; 1,300 feet of 32-inch; and 800 feet of 24-inch lock-bar pipe, together with necessary wyes, branches, manholes and other appurtenances.

Proposals were called for both riveted steel pipe and lock-bar pipe, the difference in carrying capacity of the two types being taken into consideration. On comparison of prices bid and also friction losses, we decided to select the lock-bar type instead of the riveted steel pipe.

Very rigid requirements were set up in the specifications and were strictly adhered to, particular attention being paid to fabrication, dipping, and field joints. A hydrostatic test of 150 pounds per square inch was required, to be maintained for a period of twenty minutes.

Very few leaks and about ten sweats had to be recaulked. No leaks appeared along the lock-bars, all were in field joints or at flanges.

No particular construction difficulties were encountered during the installation of the pipe. The main was located on an unimproved street, where there were only a few houses to contend with and no pavement to cut and replace. The contractor used two gas driven dragline scrapers to excavate the trench, and a gasoline driven crane to place the pipe and valves.

In general, the job is first-class in every respect, and I wish to commend the Western Pipe and Steel Company of California for the workmanlike job they have installed for the City of Sacramento.

The new Sacramento pipe line is Lock-bar construction, except wyes, short sections, etc. This picture shows four connections leading from filtration plant.

The Development of Sacramento

From the time Captain John A. Sutter established his trading post in 1839, to the present time when the city has an estimated population of 110,000, Sacramento has been one of California's important communities. It was the gateway to the gold rush of '49; became the State capital in 1852; presided over the agricultural and industrial development of its rich valley during the following half dozen decades; and stands today as a progressive modern metropolis, and one of the wonder cities of the West.

During the past six or eight years, the growth and development of Sacramento have been nothing short of phenomenal. This may be illustrated in a number of ways. The population of 65,908 shown in the 1920 census, when compared to the present estimated population, indicates an increase of nearly 67%.

Building permits in 1920 totaled slightly less than $3,500,000. For 1927, they totaled not far short of $9,000,000, and this latter figure was over $1,000,000 in excess of the total for 1926.

It is interesting to note that of the total building permits issued in 1927, $3,948,358 represented permits for new residences and apartment houses. This represents a solid and substantial growth, which is further reflected in the fact that the domestic water connections, which totaled for 1927, 20,095, represented an increase of 7,187 over 1920, or 55.07%.

As a matter of fact, the annual average of building permits issued for new construction for the past six years has been in excess of $9,000,000. It is the opinion of well informed Sacramento business men that 1928 will equal and, perhaps, exceed this record. Already there is in sight well over $3,000,000 in major building projects.

Sacramento's growth in the past few years is largely attributable to its development as an industrial and manufacturing center. As evidence of this, it is estimated that the industrial activities of the Capital City maintain approximately one-fifth of the total population.

As remarkable as has been the growth of Sacramento, it is no more than fair to say that it has done well, indeed, to keep pace with the tremendous development of the vast agricultural empire of which it is the hub.

It has been said that the turning point in the agricultural, industrial and commercial development of the entire Sacramento Valley section was reached only within the last ten years. This means that the turning point was marked by the completion of the great system of levees erected as a barrier behind which the flood waters of the Sacramento river and its tributaries are held in safe control.

Up to the present time, over $100,000,000 have been expended in the construction of levees, reclamation works, and irrigation systems that now put to profitable use the flood waters which formerly brought with them devastation and destruction. As a result of this great program of flood control, thousands upon thousands of acres of rich bottom lands, which had been subject to annual floods for countless centuries, have been transformed into intensively farmed orchards and vegetable gardens.

No section of California can boast of greater diversity of crops, of heavier production per acre, or of higher quality products than this rich and fast growing district around Sacramento.

PLACING LONG SECTION OF PIPE WITH ELBOW, CITY OF SACRAMENTO'S N
Wagner, City Engineer of Sacramento, consists of approximately 8,700′ of steel pipe from
population growth, which ha

EEL WATER MAIN.—*This new line, which is described in an article in this issue by Allan J.*
24" in diameter. The installation of new mains was necessitated by Sacramento's phenomenal
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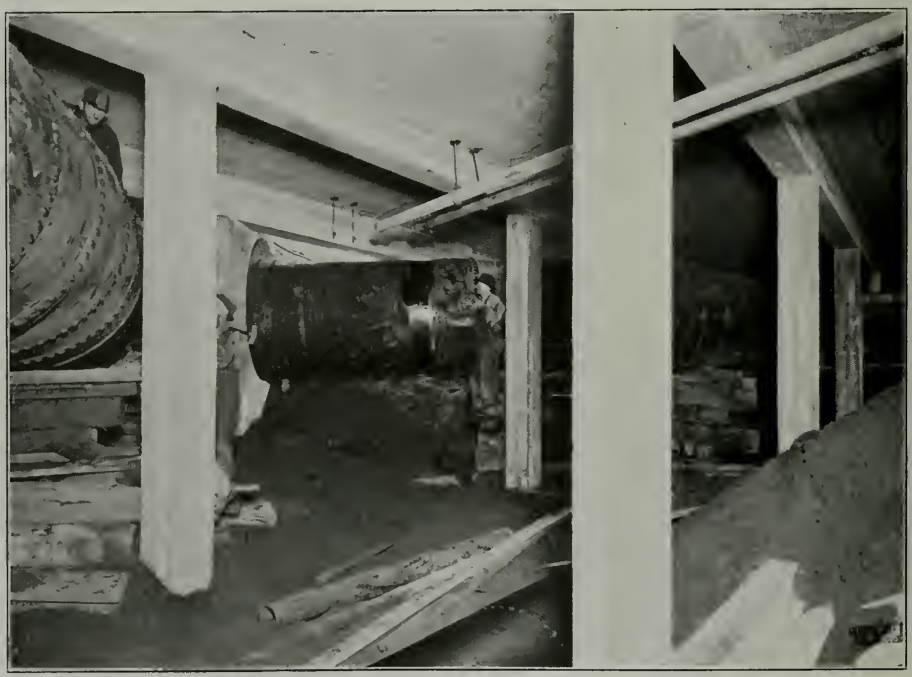
WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA is proud that much of its history is connected with the development of the Sacramento Valley. Throughout this vast territory, we have been privileged to supply a wide variety of products. Steel water pipe for municipalities, irrigation and reclamation projects, public utilities and mining operations; well casing, corrugated culvert pipe, steel tankage; these are only a few of the products that have gone from our shops to serve in the development of the great Sacramento Valley.

One of the natural conditions resulting from Sacramento's extraordinary growth was a "water problem." What this problem was, and how it has been met, is discussed in an article in this issue by Allan J. Wagner, City Engineer of Sacramento. With the installation of the lock-bar steel pipe fabricated by Western Pipe and Steel Company of California, the City of Sacramento now has in its water system between fifteen and sixteen miles of steel pipe.

With the installation of the new mains, and the doubling of the capacity of the city's filtration plant, it is believed that Sacramento's water problem has been solved for the time being.



The above picture shows pipe leading from beneath filtration plant of the City of Sacramento.

Sacramento was obliged to build this new Lock-bar water main to take care of its steadily growing population.

Lock-bar steel pipe was selected by the City of Sacramento because of its economy, greater carrying capacity, and lower friction losses.

THE CITY OF SACRAMENTO CHOSE LOCK-BAR STEEL PIPE FOR ITS NEW WATER MAIN. — *This interesting view shows pipe line with riveting of field joints completed.*

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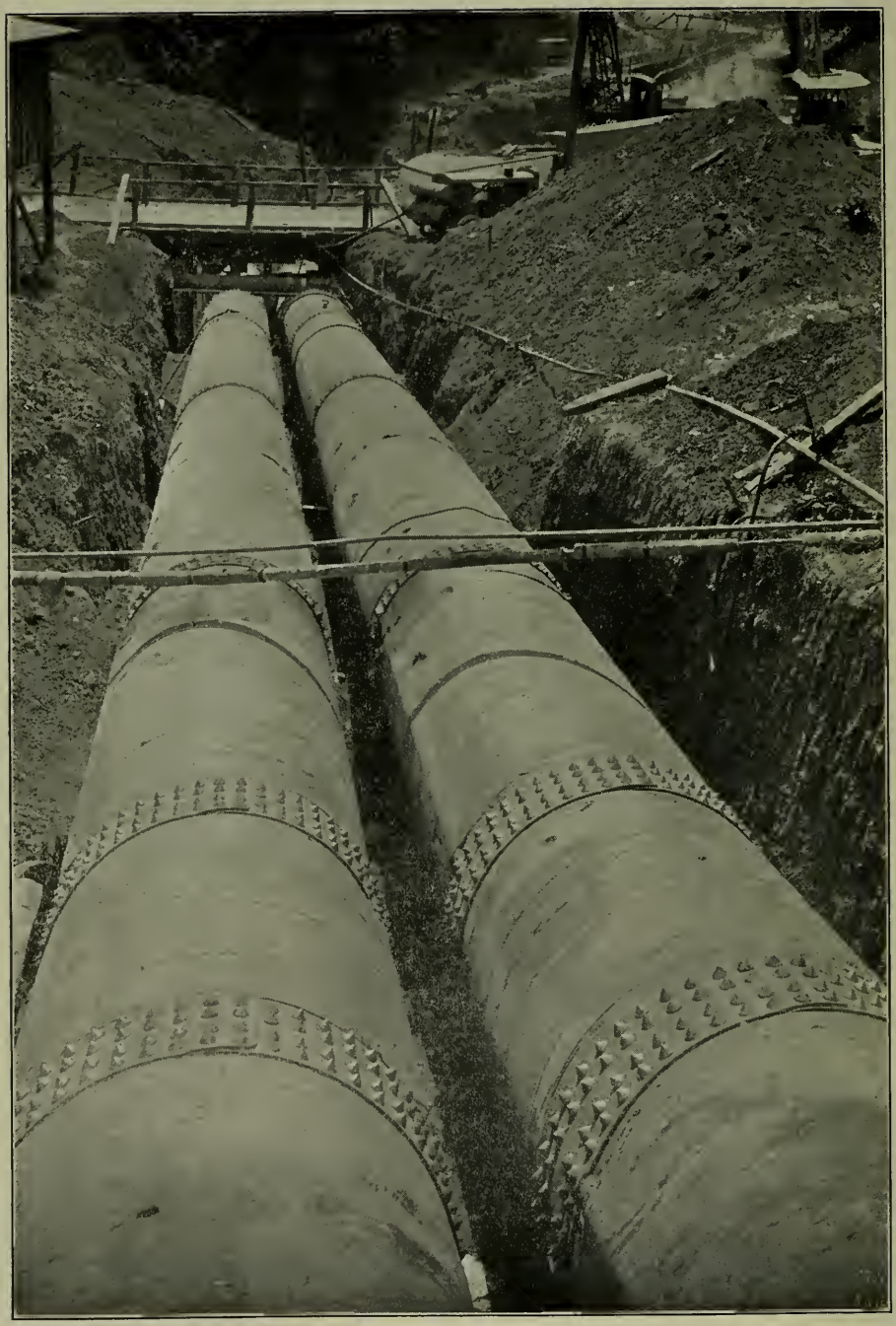

ROCKRIDGE SIPHON, EAST BAY MUNICIPAL UTILITY DISTRICT.—*This picture illustrates the installation of the parallel conduits as described in Mr. Hanna's article. The Lock-bar pipe sections have been covered with soil-proof wrapping, but the field joints are, as yet, unwrapped. This is probably the longest straightaway in the line.*

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The Rockridge Siphon and San Pablo Wasteway and Screening Chamber

By F. W. Hanna, *M. Am. Soc. C. E.*

Chief Hydraulic and Designing Engineer, East Bay Municipal Utility District, Oakland, California

The East Bay Municipal Utility District is at present engaged in construction of a water supply system for nine cities along the east shore of San Francisco Bay. This system comprises the Pardee Reservoir with a net available storage capacity of 204,000 acre-feet controlled by a dam with its top at elevation 575′ sea level, a main aqueduct with a present capacity of 60 million gallons daily and a future capacity of 200 million gallons daily leading from this reservoir to a point in Berkeley within the District's boundaries, and three primary conduits within the District for connecting the aqueduct with the distribution system. In addition to the principal features of the project already referred to, there are two large spillways of a combined capacity of 66,000 second-feet in connection with the Pardee Reservoir, two large pumping plants of a combined proposed present capacity of 120,000,000 gallons daily and a storage reservoir of a capacity of about 12,000 acre-feet in connection with the main aqueduct, and three storage reservoirs of a combined capacity of nearly 1000 acre-feet in connection with the primary conduits.

The dam is of gravity type, is about 360′ high and will contain about 600,000 cubic yards of concrete; it is now under construction and is about 18 per cent completed. The aqueduct is about 93.8 miles long and contains four horse-shoe tunnels comprising about 9.1 miles long, a reinforced concrete aqueduct about 3.5 miles long and a steel pipe line about 81.2 miles long. Three of the tunnels have a diameter of 8 feet, and one a diameter of 9 feet; two of these tunnels are completed, a third about 65 per cent and the fourth about 19 per cent completed. The circular reinforced concrete aqueduct has an internal diameter of 9 feet, and is completed.

The remaining aqueduct consists of a steel pipe line varying in general from 61″ to 65″ in diameter but includes about .55 of a mile of twin 54″ diameter lines under the San Joaquin River branches. The entire steel line is nearly completed and one of the large pumping plants is completed. The tunnels and the circular reinforced concrete aqueduct have a present capacity of 200,000,000 gallons daily and the steel pipe line has a present capacity of 60,000,000 gallons daily. The pipe line section is to be supplemented later

with two additional lines bringing the total capacity up to 200,000,000 gallons daily. Two stretches of the conduits consisting of 54″ diameter steel pipe, totaling about 3000 linear feet of the conduits, have also been completed.

Of the primary conduits referred to, one leads directly northward and another directly southward from the outlet of the main aqueduct along the foothills to equalizing reservoirs at their termini, and the third leads through an equalizing reservoir towards the central business section of the District. The first 1224 feet of the last two named conduits parallel one another from the terminus of the main aqueduct across Temescal Creek to the equalizing reservoir of the latter conduit. The construction of these parallel stretches of pipes was done during 1926 by J. Welsh, who sub-contracted the steel work to the Western Pipe and Steel Company of California. This company fabricated and installed these parallel pipes under the name of the Rockridge Siphon.

The Rockridge Siphon, therefore, may be said to consist of a double line of lockbar steel pipe 1224′ long. The pipe is made up of two 7/16″ plates in sections of 30′ length with two longitudinal seams without intervening circular joints except on curves. The sections have a mean internal diameter of 54″ and are tapered to permit connecting them in the field with double riveted lap joints except on curves where the field connections were made with double riveted butt strap joints. The lines were of necessity quite crooked and involved horizontal, vertical and combined horizontal and vertical curves which required a large percentage of the sections to be joined with butt straps. Where the curvature required joints within 30′ lengths, these were made in the shop in the same manner as were the field joints on curves.

After the 30′ sections of the pipe were completed in the shop, they were subjected to hydrostatic internal pressure sufficient to develop a tensile stress of 20,250 pounds per square inch of plate, and while under this stress were hammered vigorously on both sides of the seam at one foot intervals with a ten-pound hammer. Following this test, the pipe sections were thoroughly cleaned, heated to about 450° Fahrenheit in an oven and then dipped in Hermastic Pipe Coating at about the same temperature. When the coating had cooled, the pipe was spirally wrapped with Pabco Pipe Covering weighing about 40 pounds per square, placed under a tension of about 33 pounds per foot width and adhered to the pipe with Petrolastic Cement XX.

The Rockridge Siphon was laid to lines and grades in a trench varying from about 7′ to 9′ in depth, excavated of sufficient width to give a clearance of about one foot on each side of the pipes. The pipe lines themselves were 5′ 6″ apart on centers giving a clearance between them of about one foot. As soon as the field riveting of the circular seams between the 30′ sections was done, the pipes were subjected to an internal hydrostatic pressure of 175 pounds per square inch. Under this pressure only a very few leaks appeared and those that did appear were carefully repaired. The circular seams were then covered with a coating of Hermastic Priming Solution followed by Hermastic Pipe Coating covered with Pabco Pipe Covering adhered with Petrolastic Cement XX.

During the backfilling, the pipes were maintained in circular shape by

Continued on Page Seven

The Rockridge Siphon, looking down-grade from the intake to where the steel pipes pass under the railroad tracks of the San Francisco-Sacramento Railroad.

INSTALLATION OF ROCKRIDGE SIPHON, EAST BAY MUNICIPAL UTILITY DISTRICT.—*These twin pipes are 54″ in diameter, and of the Lock-bar type of construction, the plates being 7/16″ in thickness. This picture offers an excellent illustration of the description in Mr. Hanna's article, where he says, "The lines were o*

essity quite crooked, and involved horizontal, vertical and combined horizontal and tical curves which required a large percentage of the sections to be joined with butt aps. Where the curvature required joints within 30' lengths, these were made in the p in the same manner as were the field joints on curves."

Western Pipe and Steel News

PUBLISHED BY
WESTERN PIPE AND STEEL COMPANY
of California

444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES

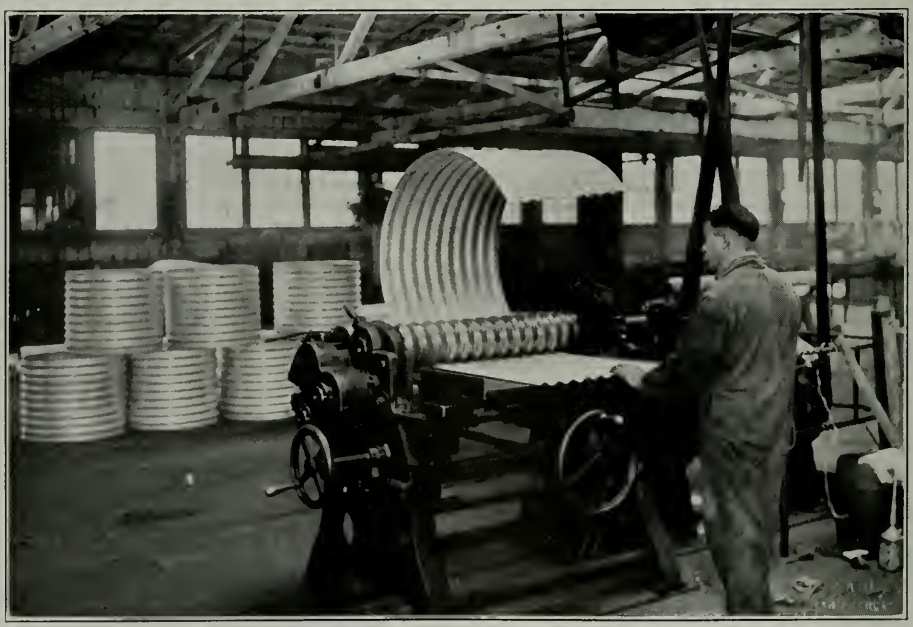
EDITED BY RICHARD PROSSER

THE East Bay Municipal Utility District is constructing a water supply system that will serve the future requirements of nine municipalities situated on the eastern shore of San Francisco Bay. The work is being carried out under the distinguished direction of Mr. Arthur P. Davis as Chief Engineer and General Manager, with Mr. F. W. Hanna as Chief Hydraulic and Designing Engineer.

Mr. Hanna prepared the article featured in this issue, which we commend to the attention of our readers. The article begins with a broadly generalized outline of the entire project, and then develops into a detailed description of the Rockridge Siphon.

This siphon, which consists of two parallel lines of Lock-bar steel pipe, was fabricated at our South San Francisco plant, and was installed by our field forces. It will be noted that Mr. Hanna, in his article, states that "the lines were of necessity quite crooked, and involved horizontal, vertical and combined horizontal and vertical curves."

The photographs reproduced in this issue, which were taken during the installation of the Rockridge Siphon, illustrate this point admirably. That the work of fabricating and installing a pipe line under such circumstances involves tremendous difficulties, goes without saying; but that the selection of the Lock-bar type of steel pipe construction under these conditions has been amply justified by the results, is also obvious.



Shop view showing fabrication of galvanized corrugated culvert pipe for East Bay Municipal Utility District.

Continued from Page Two

means of internal water pressure. The finest of the excavated material was placed next to the pipe and thoroughly compacted. The earth was spread in layers not exceeding 6″ in thickness, moistened and thoroughly tamped, and at roadway crossings the refill was compacted with rollers. The pipes were surrounded with reinforced concrete under highway and street crossings, and were carried under the Sacramento Short Line Railroad through a culvert designed to form an underpassage also for a road.

The accompanying photographs show the character of the pipes, their alignment on the ground and their position in the trench.

As already stated, there are four tunnels in the main aqueduct. The two largest are the Lafayette Tunnel, 3.06 miles in length, and the Claremont Tunnel, 3.41 miles in length. These tunnels meet at San Pablo Creek where the combined tunnel line comes near the ground surface in crossing the creek valley. At this juncture, there has been installed a wasteway and screening chamber consisting of a reinforced concrete substructure containing a wasteway chamber at the terminus of the Lafayette Tunnel, a forebay at the beginning of Claremont Tunnel and a screening chamber lying between these two compartments, all surmounted with a reinforced concrete house for protecting the hoisting apparatus for the gates and screens used in operating the screening chamber and wasteway.

The screening chamber is separated from the wasteway chamber of the Lafayette Tunnel by means of three 6′ x 6′ cast iron sluice gates and from the forebay of the Claremont Tunnel by an equal number of similar gates. The screening chamber is divided into three equal sized compartments about 15′ x 7½′ in cross section, each having one-half full aqueduct capacity. In each of these compartments there are installed five 3′ x 15′ screens made of No. 16 copper wire with ⅛ inch mesh openings. Each screen is made up in four equal sections. The screening chambers are provided with a gate controlled sluicing channel, sump and pump.

The wasteway chamber is arranged to discharge through a wasteway channel into San Pablo Creek at a distance of 360′ from the structure. The means of discharge from the wasteway chamber into the channel is through a set of flap gates arranged to open automatically when the water rises one foot higher than the normal elevation in the chamber. The opening between these two structures is also controlled by eight 2′ x 3′ structural steel gates. These gates have sufficient capacity when the screening chamber is closed off to discharge the entire 200,000,000 gallon flow of the aqueduct into San Pablo Creek.

The wasteway channel consists of three parallel 60″ diameter No. 12 U. S. standard gage galvanized corrugated pipe, made up in 30-foot lengths of Keystone Copper Steel connected with the wasteway chamber by means of a concrete transition section and controlled at the lower end by 60″ automatic drainage gates for the purpose of keeping back inflow from San Pablo Creek when in flood. The pipe lines are laid with 5½′ distances between centers and is backfilled with an overburden varying from 15′ to 20′ of earth. Each line has a curve with a central angle of 60° 47′ and a radius of about 255′ taken up in three equal lengths. The corrugated pipe was furnished by the Western Pipe and Steel Company of California.

This is a view of Rockridge Siphon looking up-grade from the culvert beneath the railroad tracks to the intake end.

WHERE THE ROCKRIDGE SIPHON PASSES UNDER THE SAN FRANCISCO-SACRAMENTO RAILROAD TRACKS.—*After installation was completed and the pipe was backfilled, a highway was made over the top to enable vehicular traffic to pass under the tracks at this point. Note the heavy riveted butt straps that join the short sections.*

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WESTERN PIPE AND STEEL NEWS

FEATHER RIVER POWER CO.'S POWER HOUSE AND PENSTOCK, BUCKS CREEK PROJECT.—*Notable for the high head involved, 2,562', a record for the United States. Western Pipe and Steel Company fabricated and installed the riveted pipe.*

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VOLUME V MARCH, 1928 NUMBER 3

Feather River Power Co. Builds Highest Head Hydro-Electric Project in North America

By EDGAR A. BROWN, Engineer
Constant Angle Arch Dam Company

ON March 4th, there was placed in operation the highest head hydro-electric development in North America, and so far as the present writer is able to learn, in the Western Hemisphere. It is power house No. 1 of the Bucks Creek Development of the Feather River Power Co., designed to operate under a maximum static head of 2,562 feet. How long the Bucks Creek Development will hold this record is a question, for the advance of hydro-electric development is so rapid that today's wonder may be tomorrow's commonplace. High head plants are no new thing on this coast, and particularly in California where the rapid fall of numerous mountain streams makes it possible to develop unusually high heads without long conduits.

The Bucks Creek Development is situated in Plumas County, California, the power house being on the North Fork of the Feather River. This is in the very heart of a section of California that is known to tourists as a scenic wonderland. The drainage area, which is probably the most productive in the State, embraces fifty square miles. About seventy-five per cent of the utilized area is tributary to the reservoirs, thus affording a regulation of the run-off that is almost perfect.

The Bucks Creek project was the result of studies that began several years ago, looking to the storage possibilities of Bucks Meadows as one link in a projected development on the Middle Fork of the Feather River. This plan, however, was abandoned some four years ago when surveys showed the practicability of the development of Bucks Creek waters within their own watershed. It was also possible to eliminate expensive transmission lines by locating the power house on the North Fork. The Great Western Power Co. of California had already constructed a transmission line paralleling the river on the bank opposite the power house, and built another one so that now the tie-in consists of a double span across the river.

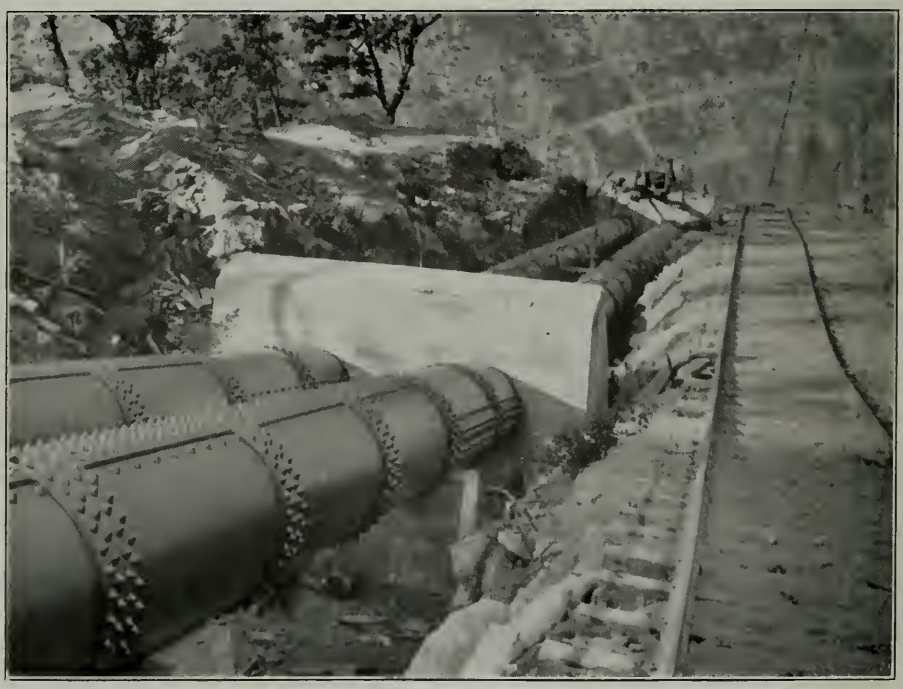
The entire output of Bucks Creek Plant No. 1 is to be sold to Great Western Power Co.

The principal units of the Bucks Creek Development are: (1) a main storage reservoir having a capacity of 116,000 acre feet and situated in what is known, locally, as Bucks Meadow; (2) a diversion reservoir situated lower down on Bucks Creek, from which the waters are diverted through a tunnel and thence into the natural channel of Grizzly Creek; (3) the Milk

Ranch Conduit and Three Lakes Reservoir, the waters from which are regulated in Bucks Creek Diversion Reservoir; (4) Grizzly Creek Forebay, which receives the entire yield of the watershed and diverts it into the pressure tunnel leading to the penstocks; (5) twin penstocks leading down the mountain-side to the power house, and (6) the power house and high-tension switchyard.

Construction work on the Bucks Creek project started early in 1925. As stated at the beginning of this article, the project was placed in operation on March 4th, last. Owing to the wild state of the region, and the comparative lack of transportation facilities, a great deal of preliminary work was necessary in the way of clearing and road building. Fortunately, however, the Western Pacific Railroad runs along the North Fork of the Feather River on the side opposite the power house; therefore, the problem of moving materials and equipment was solved by the construction of a spur track and a 120-foot steel truss bridge across the river. The next move was to construct a tramway alongside the penstock line. This tramway was 4,700 feet long, and its capacity was twenty-five tons. From the head of the penstocks to Grizzly Creek Forebay dam it was necessary to construct three miles of graded road. From the same point, the main storage dam was connected with twelve miles of narrow-gauge railroad.

The work on various units such as dams, reservoirs and the Milk Ranch

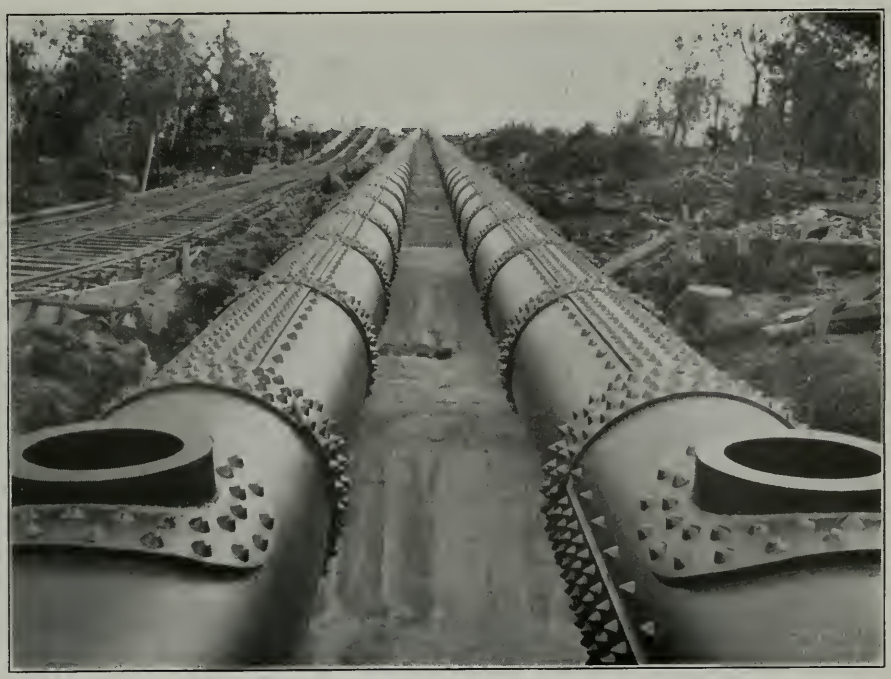


Looking down double penstock, Feather River Power Co.'s Bucks Creek Project. Top of picture shows bottom of Feather River Canyon, and Western Pacific Ry.

welded steel pipe line was limited to a rather short season, the working year running, as a rule, from June 1st to December 1st. The heavy snows made progress impossible during the winter and spring months. The tunnel work was carried on continuously, as was also work on the power house and the penstocks, although on the latter work, in mid-winter, one could drop on the tramway in a few minutes from a snow-bound region to comparative summer.

The preliminary survey of the site of the Bucks Creek storage dam indicated the advisability of a rock-fill type structure. To conserve the run-off during construction as much as possible, and not impair the stability of the structure, a concrete gravity type retaining wall was constructed to form the up-stream toe of the dam. A cut-off trench was excavated to impervious material; the rock in the bottom of the trench was thoroughly grouted, and the trench was filled with concrete. The body of the dam consisted of loose rock-fill with an up-stream facing of derrick-placed rubble. A concrete slab was placed upon the rubble face, heavily reinforced against temperature stresses.

The outlet works consist of two 42-inch sluice gates discharging through the base of the dam in two 30-inch riveted steel pipes which have as controls two 30-inch needle valves at the downstream toe. The sluice gates will be used only during repairs to the needle valves. At one end of the dam a concrete lined spill-



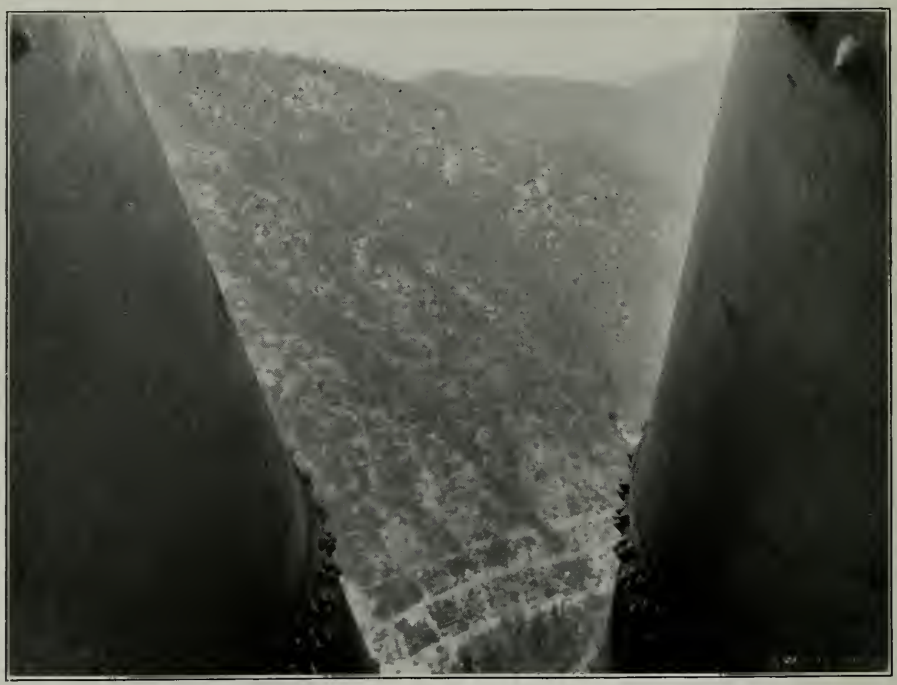
Up-grade view of Bucks Creek Project penstocks. Manholes were provided at approximately 500-foot intervals on each pipe.

way is designed to carry a flood flow of 7,000 second feet (250 second feet per square mile of watershed) and still provide 12 feet of freeboard for the dam. The principal dimensions of the dam are: Maximum height, 118 feet; length, 1,220 feet; width of crest, 12 feet; upstream slope, 1.4 to 1; downstream slope, 1.5 to 1. 303,000 yards of loose rock fill, 23,000 yards of derrick placed rock and 23,000 yards of concrete were used in its construction.

At the lower diversion point on Bucks Creek and for the forebay, the dam sites lent themselves well to concrete dams of the Constant Angle Arch type. The dams were similar in general dimensions, although at the forebay site foundation conditions necessitated deep excavations. The full water load on these dams will develop a maximum compressive stress in the concrete of less than 500 pounds per square inch.

The power house building has a concrete substructure on rock; structural steel frame; reinforced concrete superstructure and roof; steel sash. The switchboard, battery room and switch cells are located above the operating floor in an annex. The building is equipped with two traveling cranes, each having a capacity of 100,000 lbs. on the main hoist and 20,000 lbs. on the auxiliary hoist, the lift being 33 feet from operating floor to crane rail.

An interesting feature of the Bucks Creek Development is the system of remote indication and control which has been devised. By means of polarized relays, the opening and closing of the valves at the reservoirs and



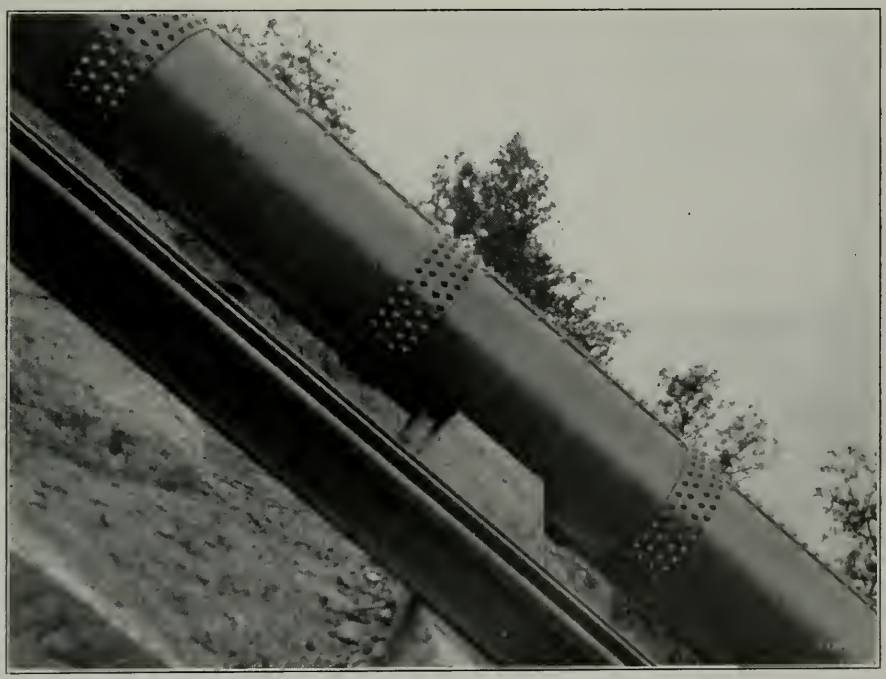
Unique view taken from between penstocks, looking almost straight down slope to Power House. Western Pacific tracks are seen plainly.

intakes to the tunnels are operated from the power house. Also, it is possible for the operator to select any one of ten valve positions at the main storage reservoir and upper diversion tunnel, or two positions at the intake to the lower tunnel. Conversely, he can read from his operating board the position at which any valve is set. In addition to this, the water level at any moment in any of the reservoirs is indicated and recorded in the power house. Through this system a flexibility of operation is attained which would otherwise be impossible.

The Milk Ranch conduit, diverting the waters of Milk Ranch Creek and Three Lakes Reservoir, and discharging into Bucks Creek Diversion Reservoir, consists of 8.05 miles of buried, soil-proofed, welded steel pipe, the diameter varying from 23 inches at the intake end to 36 inches in diameter at its terminus. The reason for the increase in diameter from intake end to discharge end is that in the course of the conduit it intercepts a number of streams which are diverted to augment its flow. The construction of a conduit of such length was justified by the high yield of its diverted area and the excellent regulation afforded in Bucks Creek Diversion Reservoir.

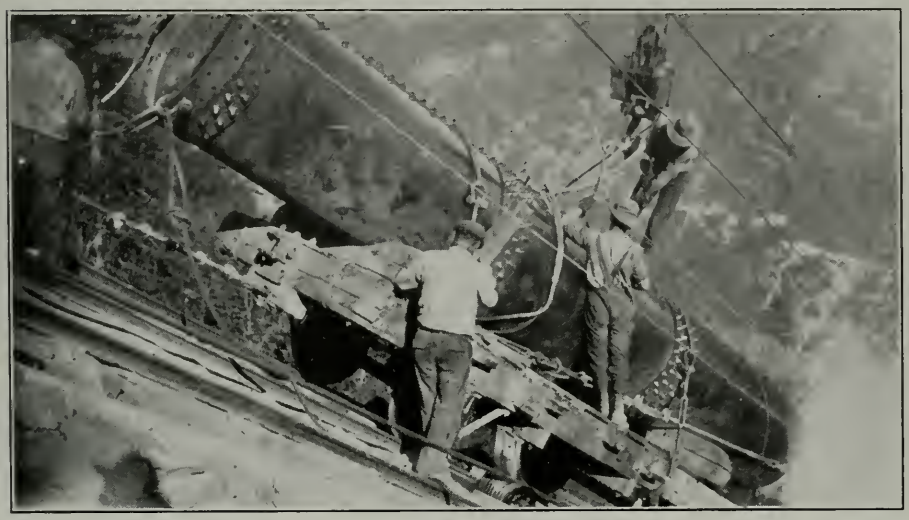
All of the engineering work on the Bucks Creek project was done by the Constant Angle Arch Dam Company of San Francisco, of which Mr. Lars R. Jorgensen is chief engineer. R. C. Storrie & Co. were general contractors for all of the construction work. Mr. Ross White was resident engineer in charge of all inspection and field engineering.

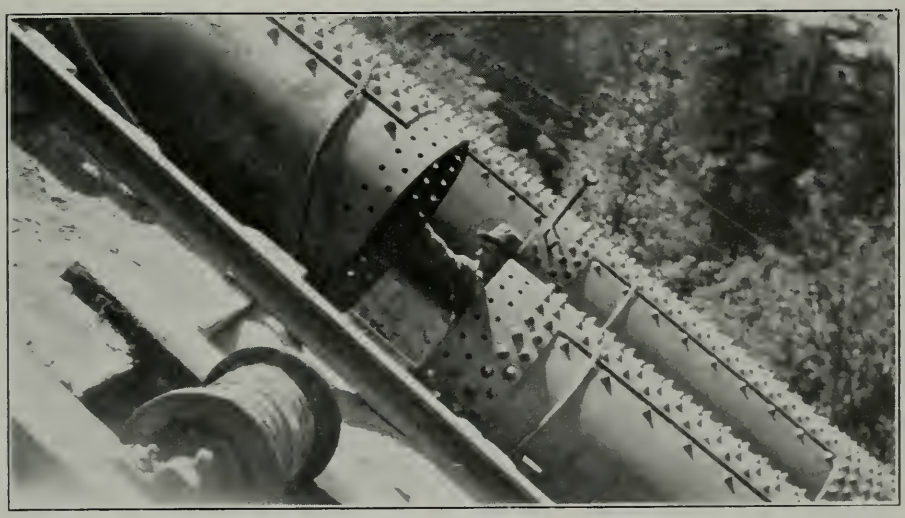
Continued on Page Fourteen



Side view of Feather River Power Co.'s penstocks. At this point the slope was 47 degrees. Rails of funicular railroad in foreground.

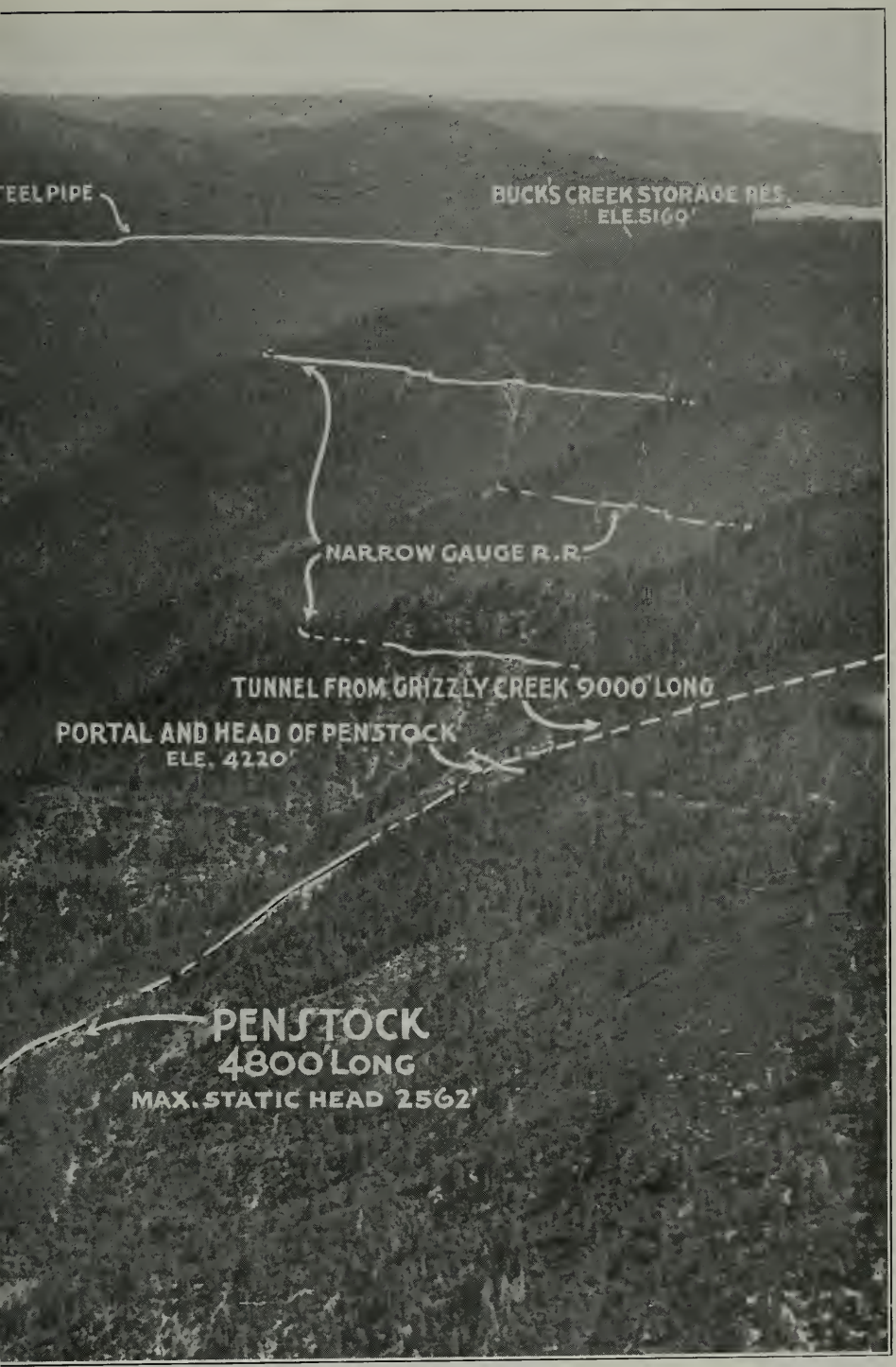
The views on this page and the page opposite show method of handling penstock sections up the inclined railway that parallels the penstock from power house to head of penstock. The difficulties of this phase of the work may be appreciated when it is stated that the average slope for the entire 4,800' is 30 degrees, maximum slope 48 degrees.





The inclined railway served the double purpose of placing penstock sections and delivering materials and equipment to the works in the high country beyond. Loads were pulled up by an electric hoist operated by a 200 h. p. motor, the equipment being designed to handle 15-ton loads at a rope speed of 300 feet per minute.

DIAGRAMMED AIRPLANE PHOTOGRAPH OF FEATHER RIVER POWER CO.'S BU
CREEK PROJECT.—*The whole story of this important development is told in the above pic*
which was specially prepared for this issue of "Western Pipe and Steel News" by engineers o



ther River Power Co. The project is notable in that it involves the highest head so far de-ned in North America, 2,562 feet. The power plant develops 70,000 h. p., and the entire output elivered to the transmission lines of the Great Western Power Co. of California.

Western Pipe and Steel News

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EDITED BY RICHARD PROSSER

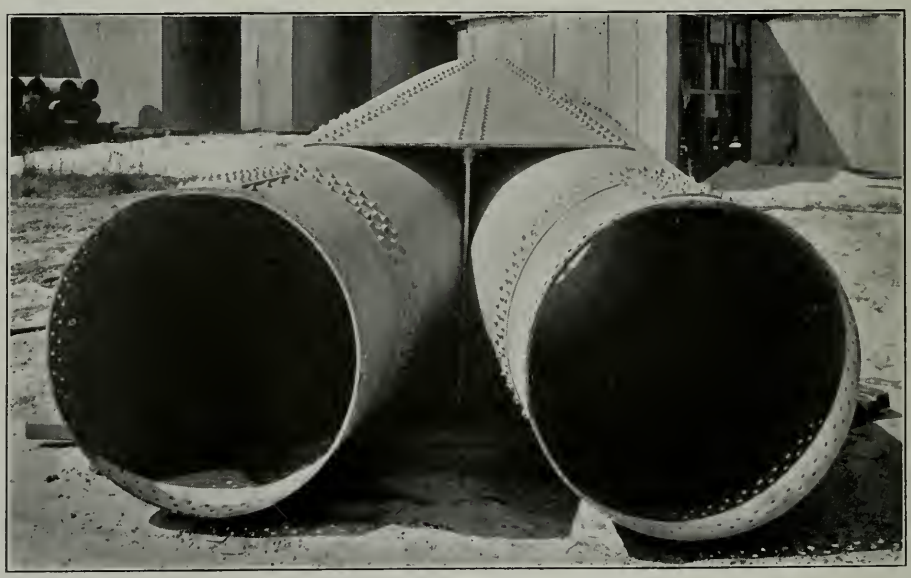
In the language of journalism, this issue of Western Pipe and Steel News might appropriately be called a special edition. It presents on a rather elaborate scale that interesting development of the Feather River Power Co. known as the Bucks Creek Project.

There is no small measure of satisfaction in participating in an engineering achievement of this character, and particularly in having fabricated the riveted steel pipe and installed the penstocks that will utilize the record head on this continent of 2,562 feet.

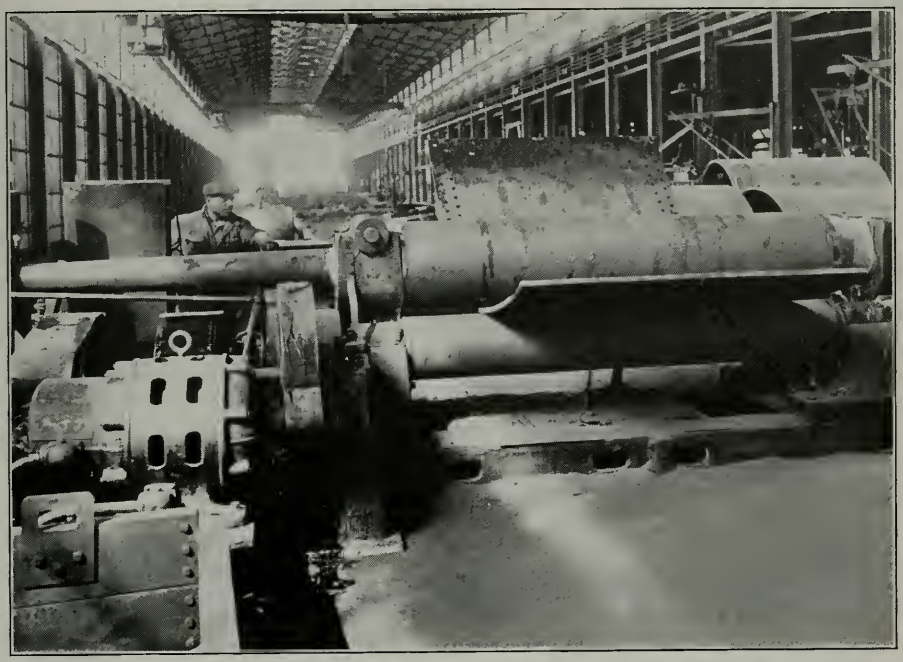
The engineers concerned with the Bucks Creek Project say positively that this is the highest head known in North America, and so far as they have been able to ascertain, in South America, as well.

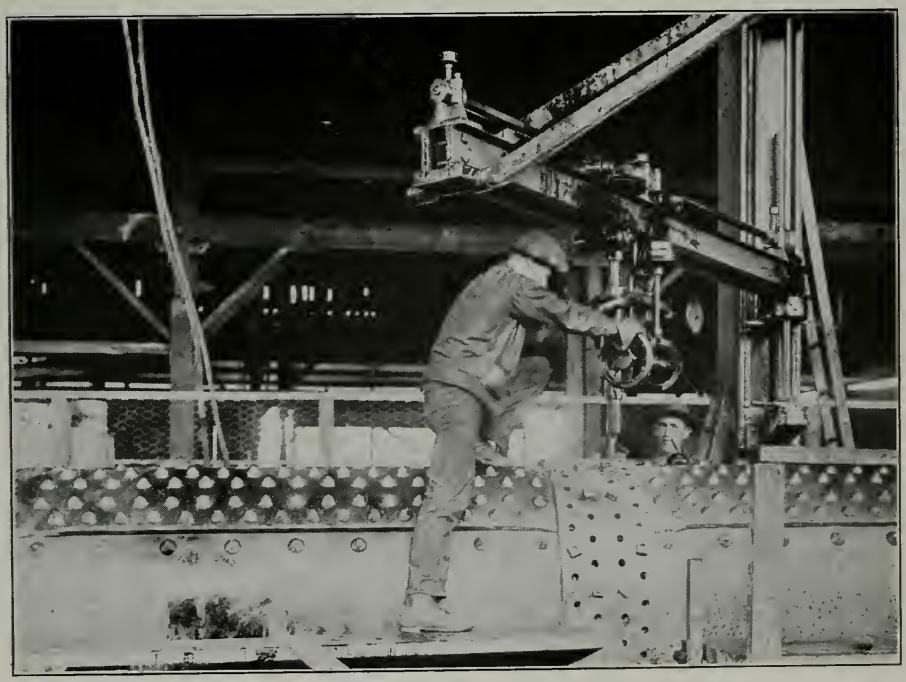
The main article in this number describes in detail the entire project. The illustrations, reproduced from photographs specially obtained, show many interesting features of the installation of the penstock as well as the eight miles of welded steel pipe conduit that is an important link in the project. It seems appropriate here, to mention the fact that we sublet to the firm of Brown Brothers Welding Co., of San Francisco, the contract for welding the field joints on the Milk Ranch Conduit.

We are deeply indebted to the engineers of the Feather River Power Co. and of the Constant Angle Arch Dam Co. for the unselfish co-operation in the preparation of the material here presented. We are confident that every one of our readers, whether engineers or laymen, will find this an exceptionally interesting presentation of an important hydro-electric project.



At the head of the penstock, this wye was installed, connecting the 80" steel pipe from the surge chamber to the tunnel portal with the two 54" penstocks.





Fabricating Feather River Power Co.'s penstocks at South San Francisco. Upper view shows 1¼" steel plate passing through rolls. Lower, drilling rivet holes through butt strap.

Installation of welded steel pipe on that part of the project known as the Milk Ranch Conduit. There were 8.05 miles of this steel pipe, all of which was wrapped with soil-proof covering and buried in trenches.

These additional views of the Milk Ranch Conduit installation show the crookedness of the line and the nature of the terrain. Bevel joints were necessary in almost every section of the entire line.

Continued from Page Five

Western Pipe and Steel Company of California fabricated at its South San Francisco plant the riveted steel penstocks, and the entire line, including the banded steel pipe, was erected by Western Pipe and Steel field crews. The banded pipe with its special fittings and expansion joints was purchased by "Western" from the Ferrum Company of Poland. The entire 8.05 miles of the Milk Ranch Conduit was also fabricated by Western Pipe and Steel Company. The field joints were made by oxy-acetylene welding. It is interesting to note that although this welded pipe was made up in sections only 14 feet long, bevel cuts were required on practically every joint in the line, because of the crookedness of the route. As a matter of fact, the length of sections had to be reduced to 7 feet in the gullies in order to keep the joint angularity within the set maximum of 15 degrees.

The upper tunnel, which receives water from the Bucks Creek Diversion Reservoir and carries it through the ridge between Bucks Creek and Grizzly Creek, is 5,650 feet in length, and is driven on a uniform grade of 2.5 feet per 1,000 feet. The flow through the tunnel is controlled by a 5-foot diameter cylinder gate in a concrete tower in the Diversion Reservoir.

The lower tunnel carries waters from the forebay through the same ridge at a lower point, to its portal at the head of the penstock line. The lower tunnel is under pressure, the static head at its lower portal being 100 feet. The good character of rock through which this bore was made called for very little lining. The average grade is 5.25 feet per 1,000 feet. Control is afforded by two 36-inch x 72-inch sluice gates located in a concrete tower in the forebay.

The twin penstocks of the Bucks Creek power plant represent the most advanced type of high head water conduit and are the result of the most scrupulous design, fabrication, and test. Exhaustive analyses were made of the conditions under which these pipe lines would operate, special study being given to the subject of water hammer. Some recent ruptures on high and moderately high head penstocks have been attributed to water hammer conditions set up by too rapid gate closures, the failures usually occurring in the middle or upper third of the pipe line.

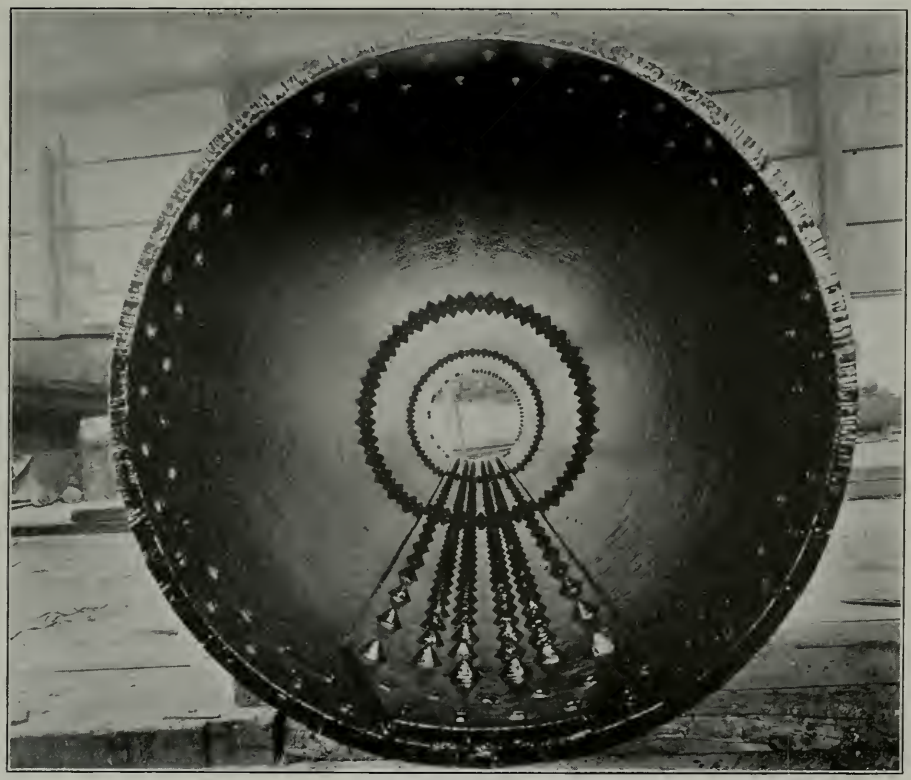
With these experiences elsewhere as a warning, the Bucks Creek penstocks were so designed that in case of instantaneous closure of the gate valves at the power house, the resulting water hammer would produce a stress in the material of not more than 70% of the elastic limit of the steel.

Many types of pipe were investigated, with the result that triple riveted double butt strap steel pipe was employed from the upper end of the line down to a point where the static head was 1,249 feet. This section of the line ranged from 54-inch diameter, 5/8-inch thick at the upper end, to 42-inch diameter, 1 1/4-inch thick at the lower end. From here to the power house the pipe is 36 inches inside diameter, "Ferrum" banded pipe, varying in thickness from 19/32-inch to 63/64-inch (exclusive of bands), and with a uniform inside diameter of 36 inches. At the power house each pipe branches to two 26-inch pipes leading to the nozzles.

The two penstocks are laid parallel, 7 feet apart, and are supported on concrete piers with pressure-lubri-

cated friction plates. At each change in alignment the pipes are anchored by gravity type concrete anchors. Each section of pipe between anchors is provided with expansion joints, while protection against collapse from sub-atmospheric pressure is doubly insured by adequate air valve installations. As an additional precaution the penstocks are equipped with gate valves next to the nozzles in the power house and by butterfly valves at the tunnel portal. Fluctuations of flow are balanced with a surge chamber excavated from the tunnel to the surface a short distance from the portal. The measurement and log of flow through the penstocks is maintained by a General Electric flow meter of the latest type.

The penstocks, which are 4,800 feet long, begin at the lower end of the surge chamber, and from the surge chamber to portal, consist of triple riveted lap-joint pipe 80 inches in diameter, made of ⅜-inch steel plate. The length of this section is 145 feet and it is protected by trash racks at the upper end to catch any debris. The 80-inch line terminates just inside the portal of the tunnel in a wye, branching into two 54-inch pipes. This wye, of which a shop



This unusual picture, taken at Western Pipe & Steel Co.'s South San Francisco plant, shows at close range a section of 1¼" penstock for the Feather River Power Co.'s Bucks Creek Power Plant No. 1.

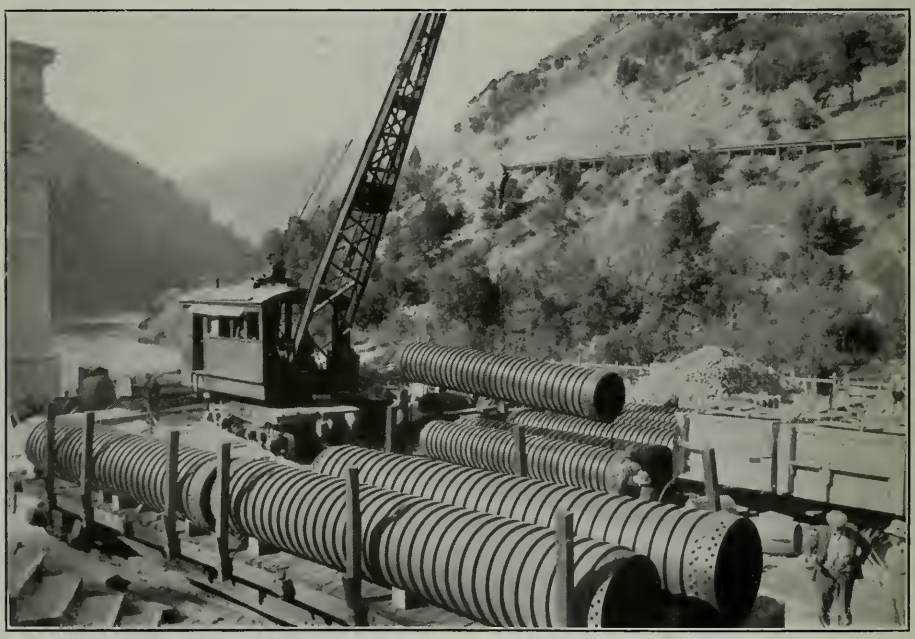
picture is reproduced on page 10, is imbedded in concrete to the point where the lines become parallel.

The static head at the upper end of the penstocks is 97 feet, while at the power house it is 2,562 feet. From the upper end of the penstock, for a distance of 2,100 feet, the lines consist of triple riveted double butt strap pipe made up in 24-foot sections, and range in diameter from 54 inches to 42 inches, and in thickness from ⅝-inch to 1¼-inch. The lower 2,700 feet of the penstock consist of the heavily banded "Ferrum" steel pipe made up in 20-foot sections. The total amount of steel used in penstocks and accessories was 3,594 tons. As the parallel lines approach the power house, they diverge so that they enter the plant 56 feet apart. A cast steel wye divides each of the 36-inch lines into two 26-inch lines connecting to the impulse wheel nozzles.

Readers may gain some idea of the difficult topography of the country when it is stated that the average slope of the 4,800 feet penstocks is 30 degrees, the maximum grade being 48 degrees.

In each penstock there are 16 vertical bends and one alignment bend. At each bend there is provided a concrete gravity type anchor and there is an expansion joint below each anchor.

In closing this article on the Bucks Creek Project, it is only fair to say that the work of the Western Pipe and Steel Company of California was first class in every respect, and conformed to the highest standards both in the shop and in the field. The organization which this company has built up, justified in every way the reputation which it has made for itself through experience, equipment and technical skill.



The above picture shows handling of "Ferrum" banded pipe at base of incline, Bucks Creek Project penstock.

LOOKING DOWN THE PENSTOCK TO THE POWER HOUSE, FEATHER RIVER POWER CO.'S BUCKS CREEK PROJECT.—*Roof of power house is seen over trees in middle of picture. Beyond it is the North Fork of the Feather River. The lines are Western Pacific R. R. tracks.*

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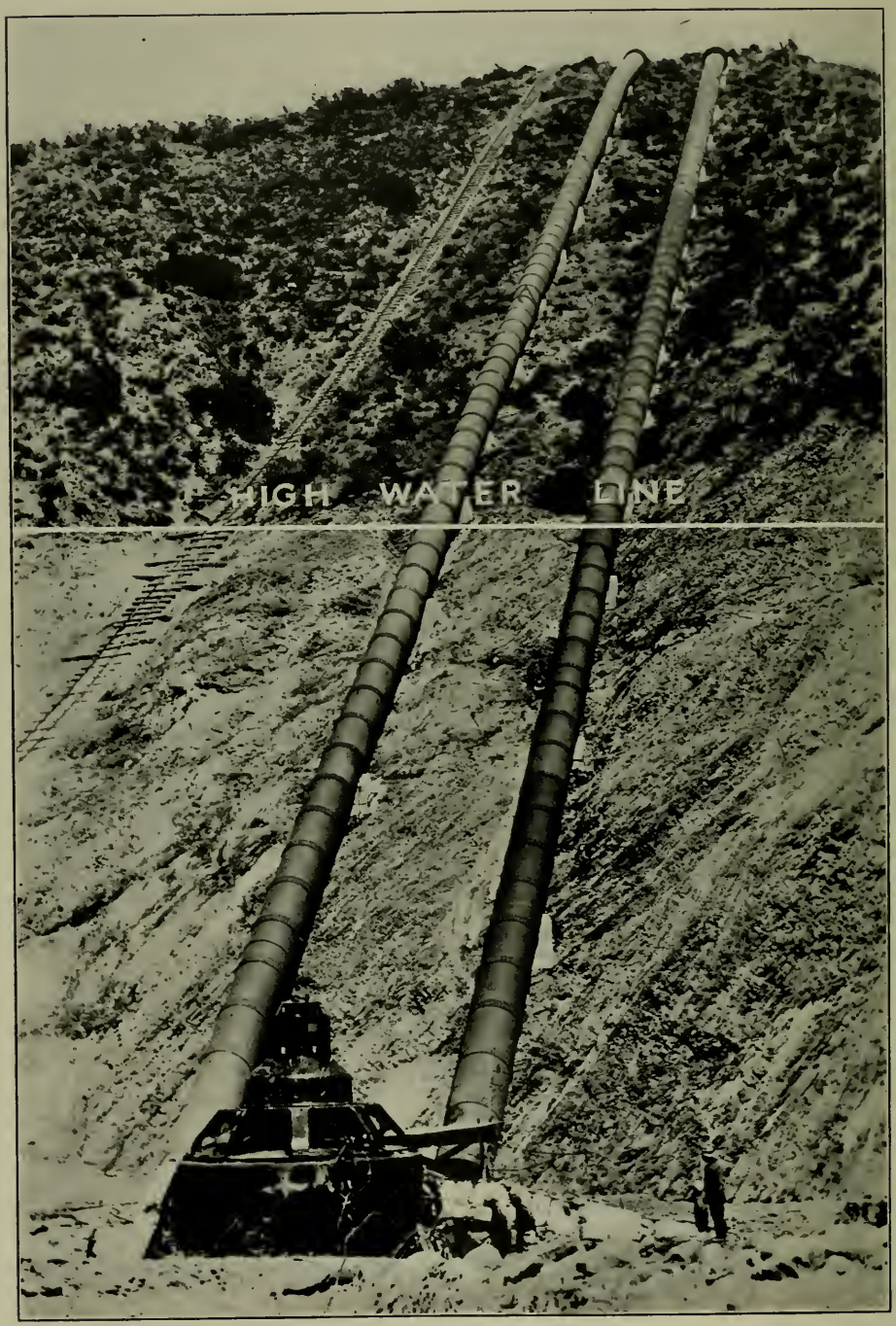
WESTERN PIPE AND STEEL NEWS



PENSTOCKS AT SAN FRANCISQUITO POWER PLANT NO. 2, LOS ANGELES BUREAU OF POWER AND LIGHT, AFTER THE DISASTER.—*The rushing waters reached the power house, a distance of one and one-half miles, five minutes after the dam broke. The velocity of the torrent was 18 miles per hour and its depth at this point was over 125 feet.*

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PUBLISHED BY

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA

SAN FRANCISCO , LOS ANGELES , FRESNO , TAFT , PHOENIX

VOLUME V APRIL-MAY, 1928 NUMBER 4

Penstocks at Power Plant Below St. Francis Dam Found Undamaged After Disaster

By R. R. ROBERTSON, Assistant Engineer
Construction Division, Bureau of Power and Light, City of Los Angeles

ON the morning of March 13, 1928, the San Francisquito Power Plant No. 2 of the Los Angeles Bureau of Power and Light, located approximately one and a quarter miles below the St. Francis Dam, was swept away by the waters released when the dam gave way.

The power plant building was a well built reinforced concrete structure, 86 feet by 126 feet, and of a height of 60 feet above the ground line.

This plant contained two vertical reaction turbine units of 17,500 KVA capacity, which were supported on concrete pedestals surmounting the large concrete foundation block containing the draft tubes. These foundations or pedestals were entirely independent of the building itself, and together with the two penstocks were the only portions of the plant that were left practically unharmed by the flood.

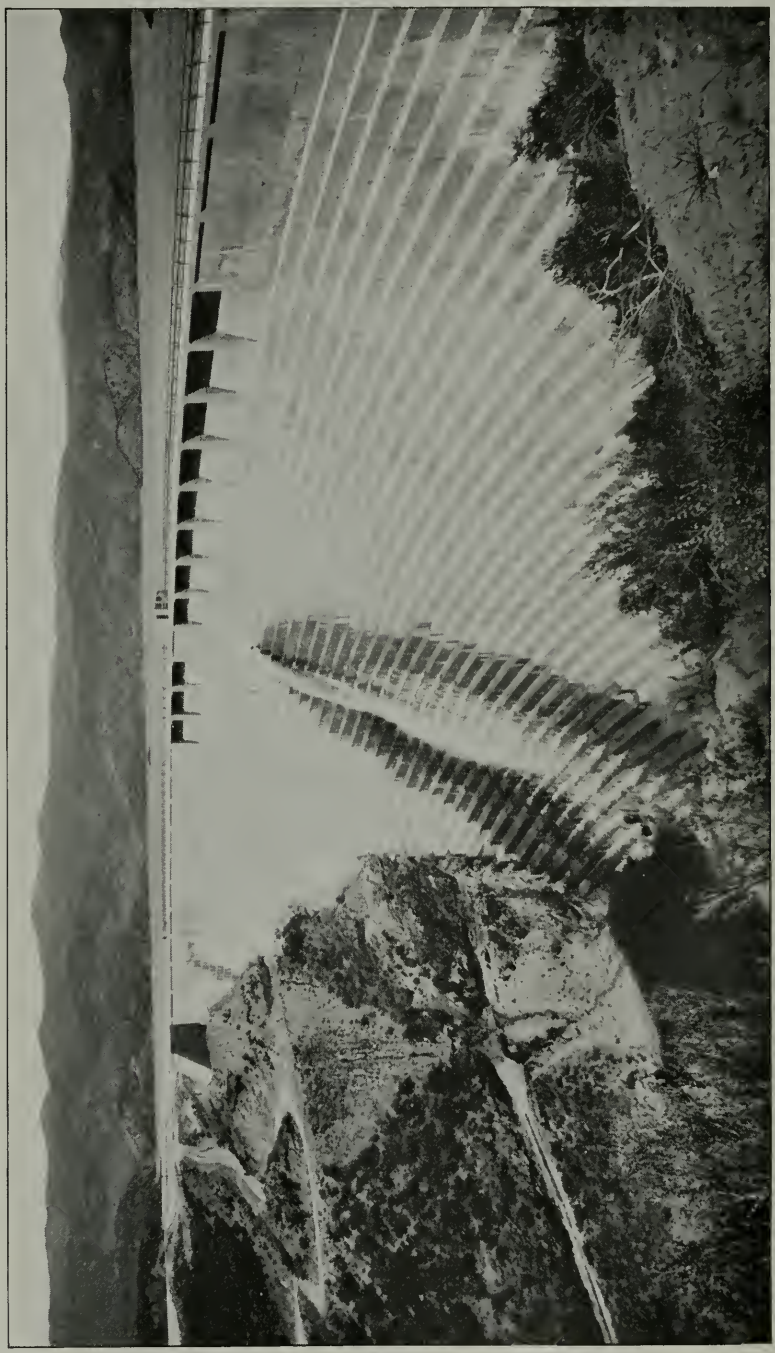
Some idea of the terrific force of the downrushing waters may be had when, by referring to the accompanying pictures, the elevation of the high water line is seen. This line is easily distinguishable by the fact that all of the shrubbery and earth below it has been removed down to the bed rock. This high water line is approximately 120 feet above the power plant floor. In addition to this, it must be remembered that it took only approximately one hour for the entire body of water to pass a given point, and carrying as it did huge quantities of gravel, sand and boulders, to say nothing of timber and other debris, it is miraculous that anything withstood it.

Further evidence of the force of the flood is shown by the distribution of some of the power plant equipment below the plant. Seven 5833 KVA transformers, weighing approximately 20 tons each; sixteen 110,000 volt circuit breaker tanks; the 100-ton, 34-foot span traveling crane; and huge pieces of concrete from the building itself, together with many structural steel girders and beams and the roof trusses spanning the generator room, were carried from 100 to 200 yards down the canyon and were buried from 2 feet to 16 feet deep in gravel and rock carried by the flood.

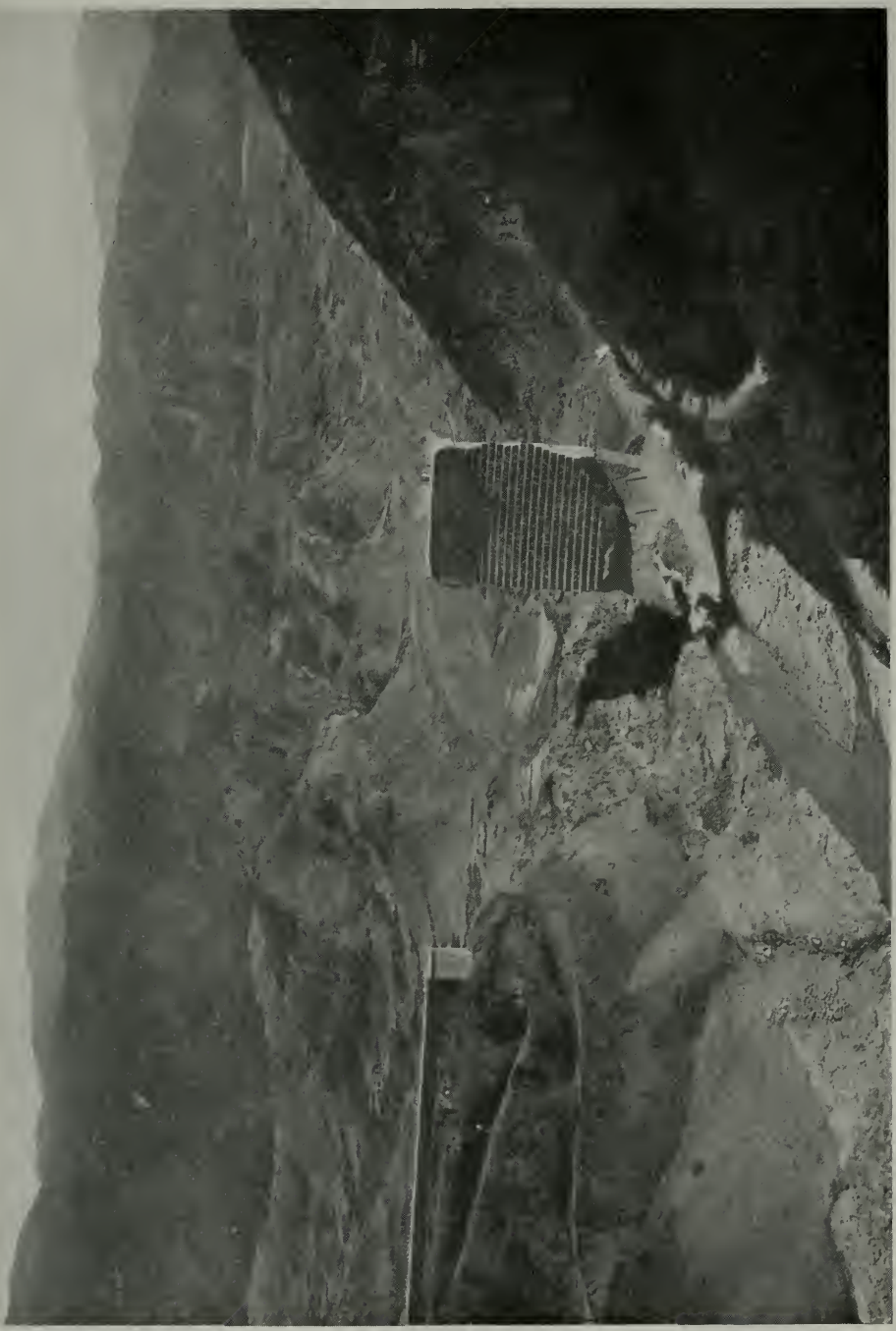
The double page picture in the middle of this issue gives a fairly good idea of the appearance of the site after the flood had passed, but does not show that the generator floor had been swept away, and the turbine room, which was approximately 22 feet deep, was completely filled with rock and sand and fragments of concrete.

The two penstocks, which were fabricated by Western Pipe and Steel Company of California and installed by the Bureau of Power and Light, are in their original position, and are apparently as good as before the flood.

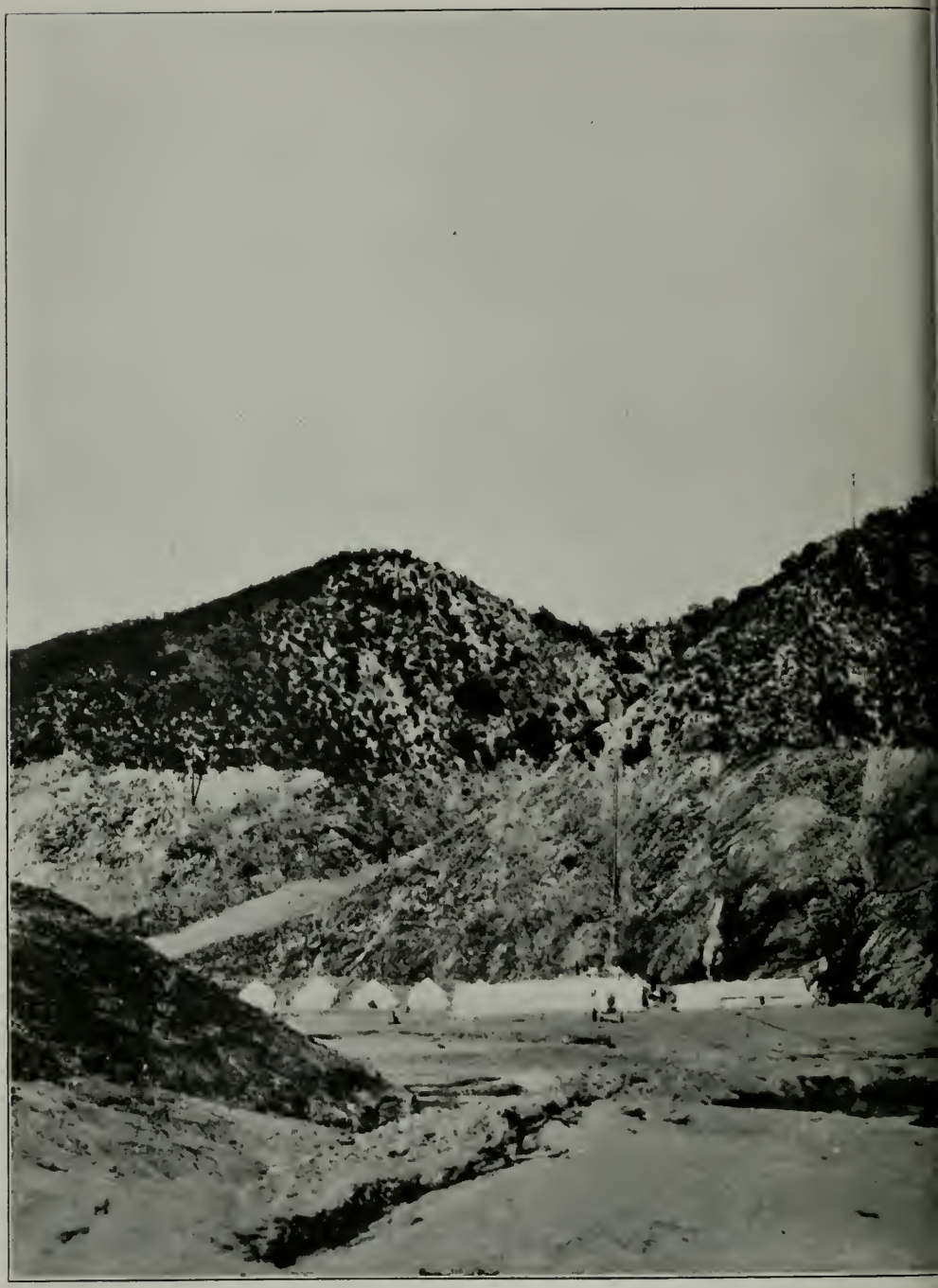
Continued on Page Six



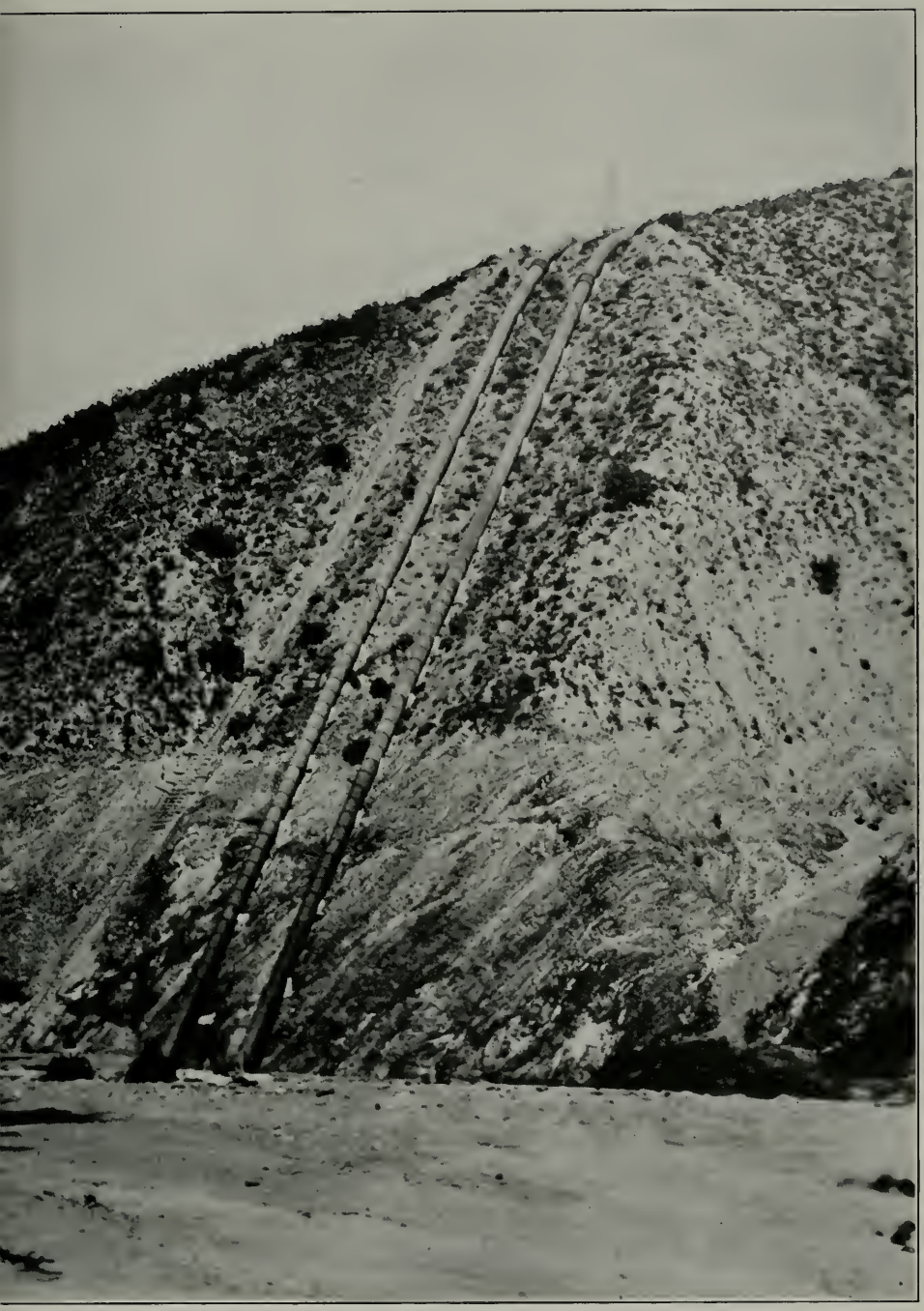
St. Francis Dam and Reservoir before the disaster.



St. Francis Dam, looking upstream, after the disaster.



SITE OF SAN FRANCISQUITO POWER PLANT NO. 2, OF THE LOS ANGELES BUREAU OF POWER AND LIGHT, AFTER THE ST. FRANCIS DAM DISASTER. — *Properly to appraise the damage wrought at this point by the rushing waters from the reservoir, the picture on the front cover should be carefully studied. It shows the rugged concrete construction of the power plant, which the above picture shows to have been swept clean to its foundations. All that*



nained was the penstocks and the turbines. The latter were supported on concrete pedestals ich were independent of the building itself. The high water mark of the flood, which was r 125 feet deep here, is plainly discernable along the hillside. The penstocks were found to be lamaged and one of them has been in constant use since the disaster as a link in the Los Angeles ueduct system.

Western Pipe and Steel News

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WESTERN PIPE AND STEEL COMPANY
of California
444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES

EDITED BY RICHARD PROSSER

THE St. Francis Dam disaster has long since passed out of the field of news, but in many respects the subject is still of interest to engineers. For this reason we are presenting pictures illustrating the remarkable manner in which the steel penstocks of the power house withstood the incalculable force of the rushing waters. A graphic description of what happened at the power house, and a report on the present condition of the penstocks is embodied in Mr. Robertson's article.

According to the engineers on the Commission appointed by Governor Young to investigate the disaster, the flood peak immediately below the dam probably exceeded 500,000 second feet. Some idea of its tremendous force may be gained from the statement that blocks of concrete weighing as much as 10,000 tons were carried for a distance of several thousand feet downstream. The report of the Commission says further:

"The distance to which large masses of concrete from the dam have been transported is probably one of the most impressive phenomena of the disaster."

Mr. Robertson's report on the condition of the riveted steel penstocks, and the pictures of them which were taken after the disaster, would seem to justify the conclusion that the manner in which the penstocks stood up was also a most impressive phenomenon. A close scrutiny of the picture on the opposite page will show that the ground at the lower end of the penstocks was washed from under the lower five sections of the pipes. Indeed, it would here be possible to drive a moving-van under the penstocks.

Continued from Page One

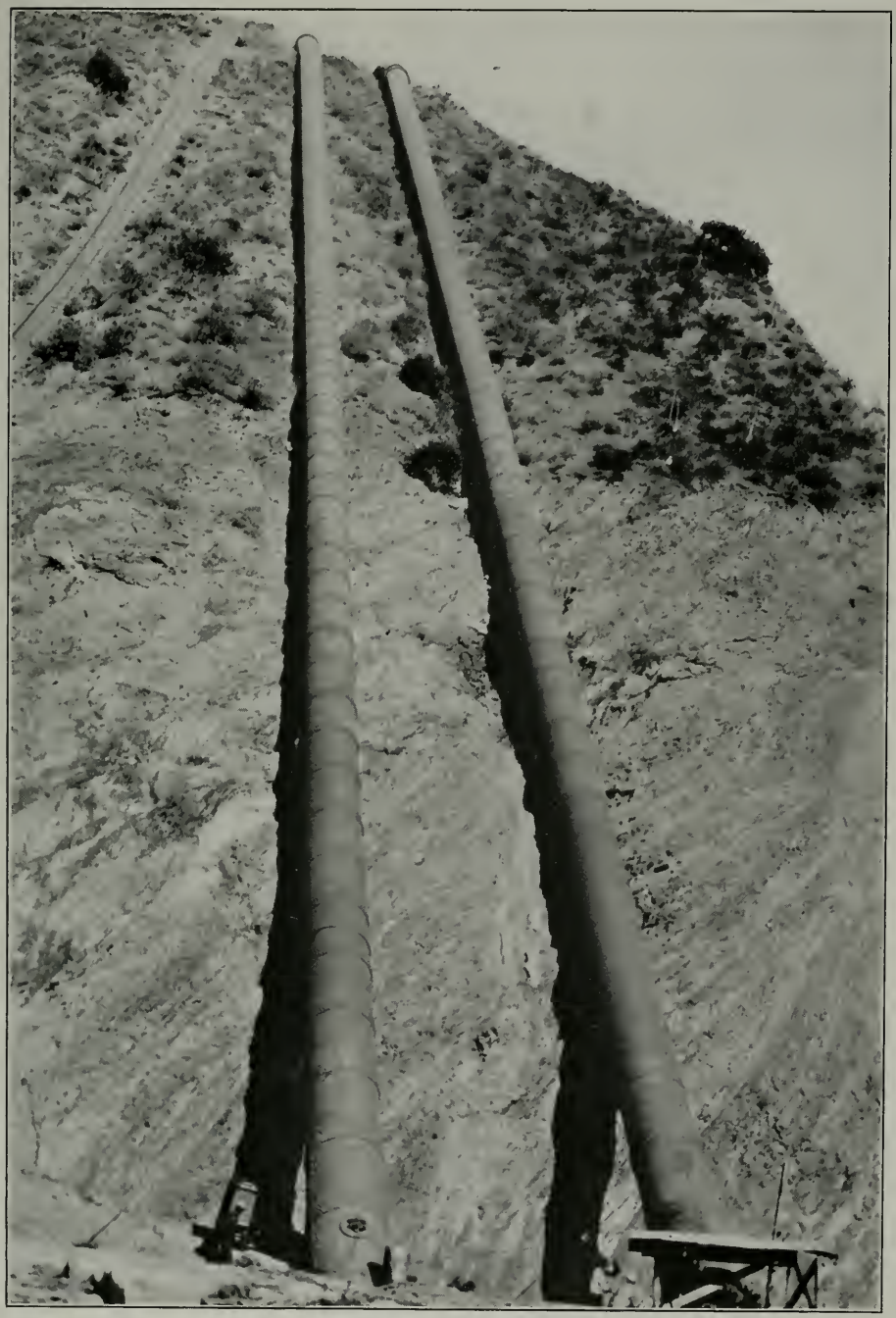
The No. 2, or left-hand penstock, should be an index of the condition of both of these, because it has been used ever since the flood for conducting water down for the Aqueduct supply, without showing any leakage or weakness.

The No. 2 unit was running at the time the flood occurred, and continued to run until 4:00 o'clock in the morning, at which time the thrust bearing burned up and allowed the rotor to drop, thus bringing it to a standstill. It was afterwards blocked into position, so as to insure its not turning, and water for the City's supply was diverted through the then stationary runner and the pressure regulator.

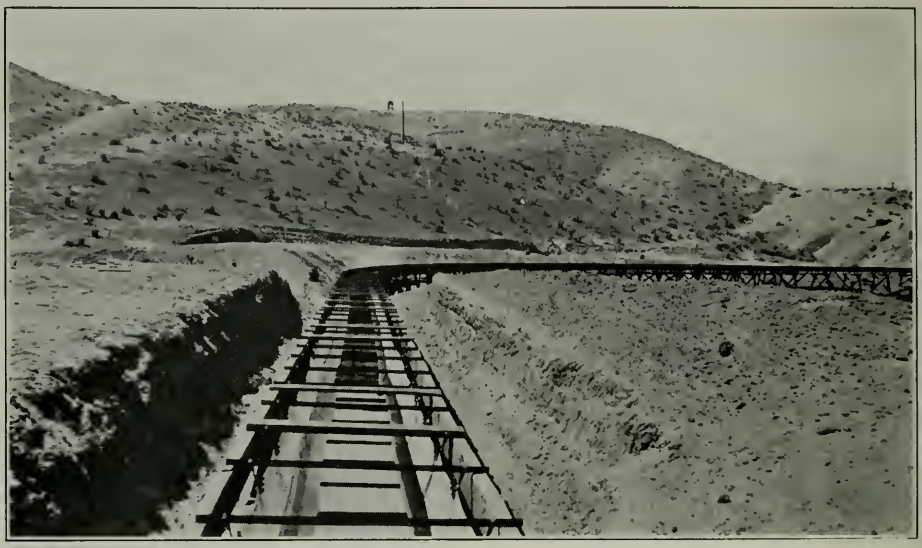
The penstocks are 7 feet in diameter at the point where they pass over the top of the hill, and step down to 6 feet in diameter and three-quarter inch plate thickness where they entered the building.

In order to take up the thrust due to expansion, heavy concrete anchors resting in pockets cut in the bedrock had been poured around each one of them. These heavy anchors; together with the fact that these pipes were full of water, thus giving great weight in proportion to the surface exposed to the force of the flood, would seem to explain why they were not swept away.

The joints in the pipe were all heavy, quadruple riveted buttstrap design, and the fact that they stood without shearing of rivets or tearing of plates under this terrific pressure, even though well anchored, speaks well for the workmanship performed by Western Pipe & Steel Company of California in fabricating them.



Another view of the twin penstocks of San Francisquito Power Plant No. 2. This picture shows the perfect condition of the steel pipes after the passing of the flood that totally destroyed the heavy concrete power house.



Western Pipe and Steel Company has made a specialty of manufacturing steel flume for many years. The above installation of 30" flume was near Taft, Calif.

Western Pipe and Steel Company's Hard Red Steel well casing, and a well rig of W. E. Bland Drilling Co. of San Jose. The picture was taken in the Salinas Valley.

PURCHASING AGENTS' REFERENCE LIST OF PRODUCTS

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OF CALIFORNIA

Absorption Plants
Accessories, Oil
Accumulators
Acid Tanks
Agitators
Air Condensers
Air Receivers
Air Pipe

Black Steel Tanks
Boilers
Bolted Tanks
Braces, Pressed Steel Car
Brine Tanks
Buildings, Steel
Burners, Refuse

Car Sills, Pressed Steel
Casing, Oil Well
Casing, Water Well
Condenser Boxes
Cooling Towers
Corrugated Culverts
Corrugated Tanks
Culverts, Metal

Dephlegmators
Dredge Pipe

Evaporators

Filters
Fire Stills
Flumes, Steel
Fuel Oil Storage Tanks

Galvanized Air Pipe
Galvanized Culverts
Galvanized Irrigation Pipe
Galvanized Tanks, Corrugated
Galvanized Tanks, Straight Side
Gas Holders
Gas Traps
Gasoline Storage Tanks
Gasometers
General Plate Work
Gravity Tanks
Grease Kettles

Heat Exchangers
Heaters
Hemispherical Bottom Tanks
Holders, Gas
Hydro-Pneumatic Pressure Tanks

Ice Cans
Irrigation Pipe, Galvanized

Kettles, Grease
Kettles, Steam Jacketed

Lock-Bar Steel Pipe

Metal Culverts
Metal Flumes

Oil Accessories
Oil and Gas Separators
Oil Refinery Equipment
Oil Storage Tanks, Steel
Oil Well Casing

Parts, Pressed Steel
Penstocks, Steel
Pipe, Dredge
Pipe, Galvanized Air
Pipe, Galvanized Irrigation
Pipe, Gas Gathering
Pipe, Lock-Bar Steel
Pipe, Riveted Steel
Pipe, Slip-Joint
Pipe, Soil Proof
Pipe, Steel
Pipe, Welded
Pressed Steel Work
Pressure Tanks
Purifier Boxes

Receivers, Air
Refinery Equipment
Refuse Burners
Retorts
Riveted Steel Pipe
Riveted Steel Tanks
Rock Screens
Roof Pressure Tanks

Smokestacks
Soil Proof Pipe
Special Fittings
Special Shapes
Special Tanks
Standpipes
Station Tanks
Steam Stills
Steel Buildings
Steel Flumes
Steel Penstocks
Steel Pipe
Steel Plate Construction
Steel Tanks
Stills
Storage Tanks, Steel
Stovepipe Casing
Structural Steel Work

Tanks, Acid
Tanks, Bolted
Tanks, Black Steel
Tanks, Brine
Tanks, Cylindrical
Tanks, Galvanized Corrugated
Tanks, Galvanized Straight Side
Tanks, Gravity
Tanks, Hemispherical Bottom
Tanks, Hydro-Pneumatic Pressure
Tanks, Oil Storage
Tanks, Pressure
Tanks, Riveted
Tanks, Roof
Tanks, Shaped
Tanks, Ship
Tanks, Tower
Tanks, Truck Single or Multiple Compartments
Tanks, Wagon
Tanks, Welded
Towers, Cooling
Towers, Steel Tank
Traps, Gas

Wagon Tanks
Water Pipe Lines
Water Well Casing
Welded Pipe
Welded Tanks
Wrapped Pipe

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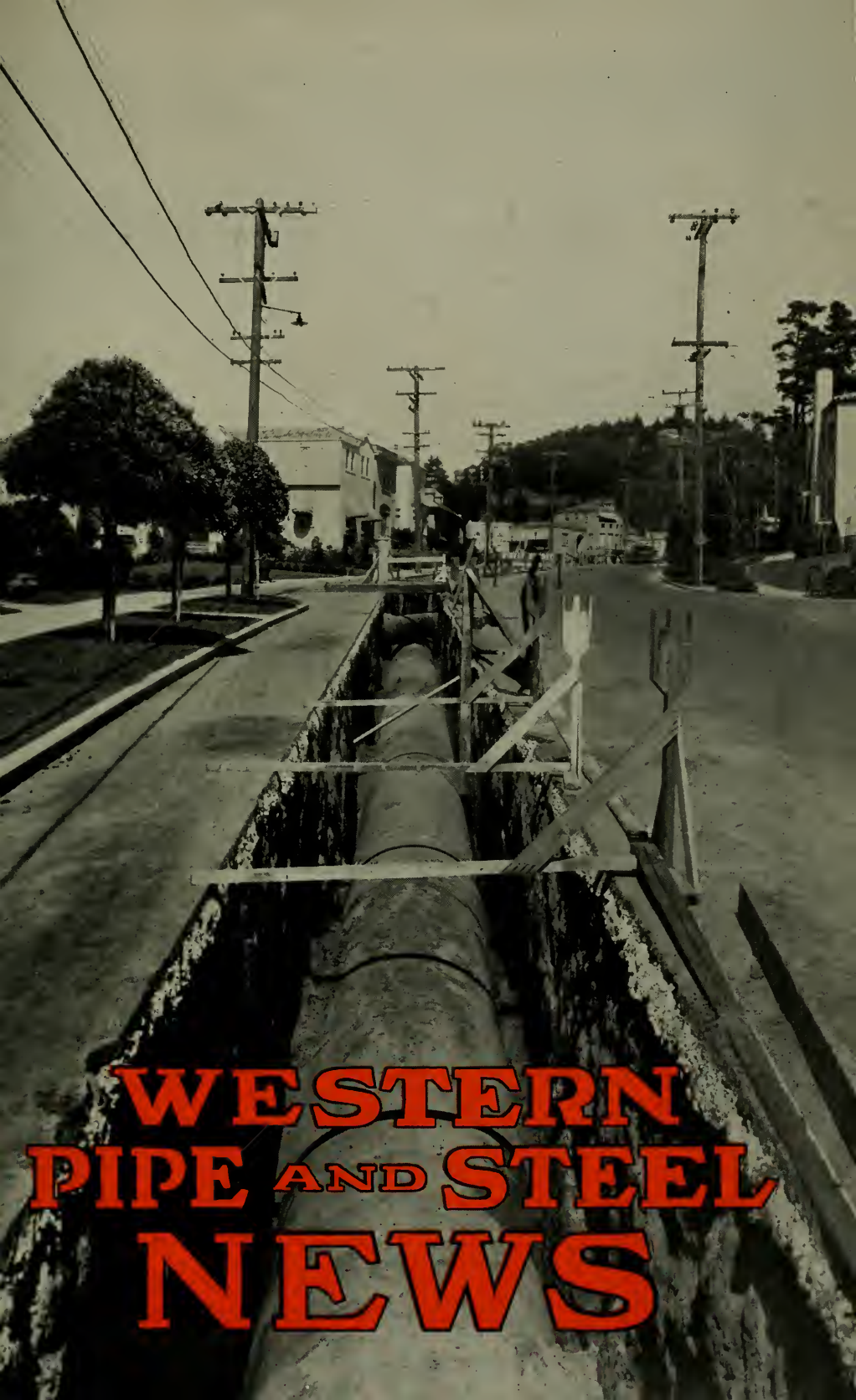

WESTERN PIPE AND STEEL NEWS

LAYING 54" LOCK-BAR STEEL PIPE THROUGH AN EXCLUSIVE RESIDENCE DISTRICT.—*Western Pipe and Steel Company installing new line for Spring Valley Water Company along Portola Drive, the main thoroughfare of St. Francis Wood. The work was accomplished with little or no impediment of traffic. After the paving was restored, none but an expert could tell that the street had been opened.*

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VOLUME V JUNE, 1928 NUMBER 5

Spring Valley Installs Eleven Miles of Lock-Bar Steel Pipe with 30 M. G. D. Capacity

By T. W. Espy, Assistant Chief Engineer
Spring Valley Water Company

San Francisco is so situated on hills and in valleys that to adequately and uniformly supply water to all parts of the city is much more complicated than it is in any other large city of the United States. To accomplish this, five main pressure districts and twenty secondary pressure districts are maintained. The highest of these districts delivers water as high as 800 feet above sea-level, and additional installations capable of delivering water to elevation 930 above sea-level are now being considered.

The immediate water supply for these twenty-five pressure districts comes from three main distributing reservoirs situated within the city limits, namely: University Mound reservoir situated at 170 feet elevation above sea-level, College Hill reservoir at 255 feet elevation, and Lake Honda at 370 feet elevation.

T. W. ESPY

About one-half of the water used in San Francisco flows from these three reservoirs to the consumers by gravity, while the other half has to be raised to higher elevations by pumping.

These three distributing reservoirs in turn receive their water from three large impounding reservoirs situated from 15 to 25 miles distant to the south in San Mateo County. The water from these impounding reservoirs is transported through three large wrought-iron transmission pipe lines which have a combined maximum carrying capacity of 50 million gallons of water a day. Two of these lines are thirty inches in diameter and deliver 7 million gallons a day by gravity into College Hill reservoir at elevation 255, and an additional 17 million gallons a day which is lifted by pumping into Lake Honda reservoir. The third pipe line is 44 inches in diameter and delivers 25 million gallons a day into University Mound reservoir.

For the past few years the yearly consumption of water in San Francisco has increased at the average rate of 2½ million gallons a day. During the

summer months of 1927 the consumption averaged 52 million gallons a day. There were many days during this period when the daily consumption was well over 55 million gallons. This amount was well over the maximum amount that could be transported into the city through the three present pipe lines.

To meet the requirements for additional pipe capacity to transport water from the large storage reservoirs in San Mateo County to the consumers in San Francisco, the California Railroad Commission in September, 1927, authorized a material increase in the distributing facilities within the city limits, and the construction of a new 54-inch diameter pipe line for transporting water from Lake San Andres in San Mateo County into Lake Honda in San Francisco.

Bids were immediately requested on three kinds of wrought steel pipe, i. e., riveted pipe, welded pipe, and lockbar pipe. On November 4, 1927, a contract was signed with the Western Pipe and Steel Company for the construction of a lockbar pipe line eleven miles long, beginning at Lake San Andres in San Mateo County and extending to the south portal of the inlet tunnel of Lake Honda in San Francisco.

The south portal of the Lake Honda inlet tunnel is just above the west end of Twin Peaks Tunnel at elevation 405 feet above sea-level. The new 54-inch San Andres pipe line will deliver 30 million gallons a day by gravity, and is so designed that the carrying capacity can be economically and easily increased to 50 million gallons a day by placing booster pumps on the line.

To get the water out of Lake San Andres a shaft 50 feet deep was sunk just above the east shore of the lake. From the bottom of this shaft a

Lock-Bar steel pipe, 54" diameter, in tunnel which runs under Lake San Andres, the intake being 46' below surface of water.

tunnel was run out under the lake a distance of 166 feet, where it taps the lake 46 feet under the water surface. Gates to control the flow of water were placed in the shaft. From the bottom of the shaft the tunnel was extended 748 feet through the ridge on the east side of the lake.

The 54-inch pipe line starts at the gates in the bottom of the shaft and runs out through the easterly position of the tunnel, then while following the topography of the ground in a northerly direction toward San Francisco it gradually extends down hill a distance of 3-7/10 miles to Baden where it is only a few feet above sea-level. At Baden the new pipe meets the two 30-inch diameter transmission lines already mentioned. Cross connections are being installed at Baden so that water can be transported from the new 54-inch pipe to either or both of the 30-inch lines, or vice versa.

As the pipe line from Baden runs northerly through Colma and along the Junipero Serra Boulevard to San Francisco, the elevation of the ground rises until at the San Francisco end of the new line it has attained an elevation of 405 feet above sea-level. This is just five feet higher than its starting point in the tunnel at San Andres and 41 feet lower than the surface of Lake San Andres. It is this 41 feet of extra height of water at the lake end that will push 30 million gallons of water a day through the line.

The pipe is made from "flange boiler steel" and was rolled in the Eastern mills especially for this line. The thickness of the steel plates in the pipe varies by sixteenths with the pressure the pipe has to stand, the thickest plate being 7/16-inch and the thinnest ¼-inch. The pipe is so designed that under the maximum working pressure the 7/16-inch steel

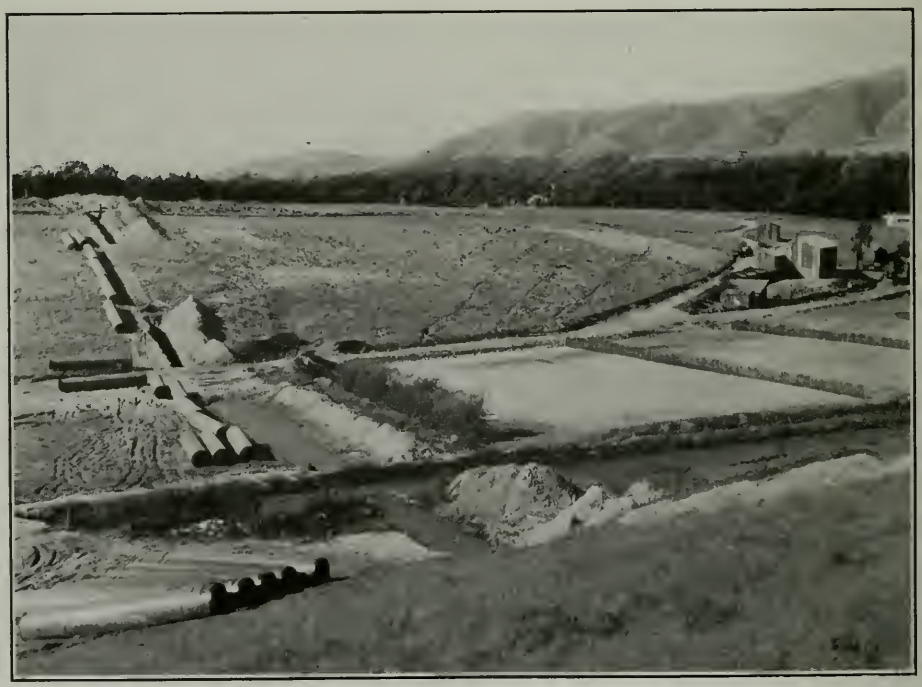
This picture was taken where pipe line traverses the countryside north of Baden. San Bruno mountain in background.

plates are stressed to 11,800 pounds per square inch of cross sectional area, while the ¼-inch plates are stressed 10,300 pounds per square inch. The working stresses in the ⅜-inch and 5/16-inch plates are 11,500 and 11,000 pounds, respectively.

All angles and bends are made with double riveted longitudinal seams and the plate in these fittings is stressed to 70% of 13,750 pounds per square inch under maximum working conditions. The thickest plate used in these riveted fittings is ½-inch.

All the pipe, after being installed in the field, is tested with internal water pressure to 1½ times its maximum working pressure and each section of pipe is given an internal water pressure test in the shop 20 pounds greater than the field test.

Lockbar pipe was first used on a large scale in Australia and has been used in the United States for over twenty years. This pipe is made in rather an ingenious manner. Two plates of steel, each 30 feet long and of the width required to make the circumference desired, have their edges upset and are each rolled into a half cylinder. One of these half-cylinders is placed upon the floor with the concave surface facing up and the second half-cylinder is placed upon the first half-cylinder with the concave side down. This gives a circular cross section or a cylinder 30 feet long. Two egg-shaped bars of steel each 30 feet long which have slots cut in each side for their entire 30 feet lengths are then inserted, one on each side, between the adjacent edges of the two half-cylinders, so that the edges rest in the slots. Then with a great press, able to exert 700 tons of pressure, the sides of the slots are pressed down securely against the two sides of the plate. Thus the



Pipe sections were trucked from Western Pipe and Steel Company's South San Francisco plant, two sections to the load, and distributed along the trench.

two half-cylinders are fastened or locked together with a bar of steel, which gives the pipe its name—lockbar pipe. This fastening is water tight and is so strong that the plate will break before the lockbar breaks.

After going through the press and having the two lockbars clamp the two half-cylinders into one complete cylinder it is called a "section of pipe" or "section." This section is next given the shop test mentioned above and then placed on four wheels and the whole 30-foot section of pipe is rolled into a huge heating oven. When all the metal in the section attains a temperature of 450 degrees Fahrenheit it is removed from the oven and lowered endways into a deep vat filled with boiling asphaltum. This asphaltum is especially produced for a pipe coating. It is so treated that it will not become brittle in cold weather and will not melt during hot weather.

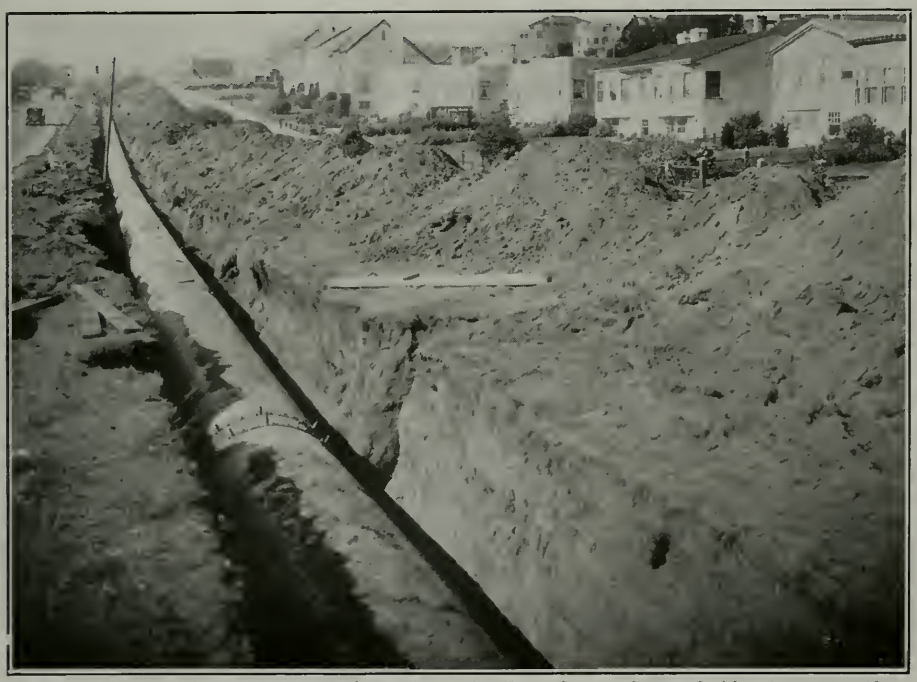
After dipping in the asphaltum the section is set aside and allowed to cool until it reaches the temperature of a warm day.

The 30-foot section of pipe is next covered with a layer of felt paper very similar to roofing paper. This paper should adhere tightly to the pipe coating, and to facilitate this a stream of hot asphaltum is squirted between the paper and pipe just as they are rolled in contact with each other. The 30-foot section of pipe is now ready to be hauled by auto truck to its proper place in the line.

A 30-foot section of pipe is quite heavy. One made of 7/16-inch plate weighs nearly six tons. All handling of the pipe both in the shop and field is done with cranes. At the trench large cranes mounted on caterpillar tractors lower the sections into place.

Each section of pipe is made with a very slight taper causing it to have

Continued on Page Nine



Where the pipe line parallels Junipero Serra Boulevard opposite Ingleside Terrace. There was no interruption to the heavy traffic at any time.

LOCK-BAR DEPARTMENT, SOUTH SAN FRANCISCO PLANT, WESTERN PIPE AN STEEL COMPANY.—*This general view, taken from the cab of one of the huge traveling crai shows many of the steps in the manufacture of Lock-Bar pipe. The plates at the extreme ri have passed through several operations, including drilling, upsetting, etc., and are ready to en*

rolls. After being rolled, the halves and Lock-Bars are assembled and drawn up with heavy l clamps. Beyond these sections in the picture is seen the hydraulic press which presses the edges the plates into the grooves of the Lock-Bars. Next comes the testing machine, heating oven, kettle, and finally, the wrapping machine.

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EDITED BY RICHARD PROSSER

WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA joins with the City of San Francisco and with members of the California Section of the American Waterworks Association in welcoming delegates to the annual convention of the national body, to be held at the Fairmont Hotel, June 11th to 15th.

This is the first time the national organization has come to the Pacific Coast for its annual convention, and although we are located on the Western rim of the continent, all of the available advance information points to a record-breaking attendance. It is expected that between 300 and 400 Eastern members of the American Waterworks Association and of the Waterworks Manufacturers' Association will come to San Francisco. Between 700 and 800 Western members will be on hand.

This number of WESTERN PIPE AND STEEL NEWS is dedicated to the convention, and we take great pleasure in calling the special attention of our readers to the illustrations covering the fabrication and installation by Western Pipe and Steel Company, of the new eleven mile transmission line which will add thirty million gallons daily to the pipe line capacity of the Spring Valley Water Company into San Francisco from San Andres reservoir; also to the interesting article specially prepared for us by Mr. T. W. Espy, Assistant Chief Engineer of the Spring Valley Water Company.

Chief Engineer Elliott and Assistant Chief Engineer Espy of Spring Valley Water Co., with party of engineers at South San Francisco plant of Western Pipe and Steel Company, just after inspecting method of fabricating Lock-Bar pipe.

Concluded from Page Five

a slight difference in diameter at the two ends, just enough difference so that the small diameter end of the section will make a tight fit inside the large end of the section placed next to it. The sections are placed together in the trench in this manner so that there is a lap of a few inches, and they are fastened together at this lap with red hot rivets.

The pipe line is being laid in a trench for its entire length. Only where it crosses the larger streams does it emerge from the ground, to be carried on trestles in the air. Over the greater part of pipe length the trench is eight feet deep. However, where the pipe follows a private right of way just adjacent to and parallel with the Junipero Serra Boulevard in San Francisco, the pipe trench reaches a depth of 15 feet. This 15-foot depth is required to conform to the grade of the proposed reconstructed Junipero Serra Boulevard, the bonds for which reconstruction have already been voted.

Six thousand feet of the trench through the streets of San Francisco were excavated with a one cubic yard steam shovel equipped with an extra long dipper stick. The rest of the eleven miles of trench is being dug with one cubic yard "drag line excavators." The bell holes for riveting the round-about seams are being dug with clam shell buckets especially constructed for digging bell holes. In order to rush the work to completion there are seven power machines being used on the excavation.

After placing the pipe in the trench through the paved streets of San Francisco a sandy texture backfill was placed by ground sluicing. This method made a very solid fill upon which to place pavement. In the country the backfill for the bottom half of the pipe is tamped into place with power tampers. The backfill in the upper part of the trench is pushed into the ditch by a bull-dozer and a 30 H.P. caterpillar tractor. Some puddling has been done at bell holes and where early solidification was desired.

The contract for this eleven miles of pipe was made November 4, 1927, and called for the line to be completed June 30, 1928.

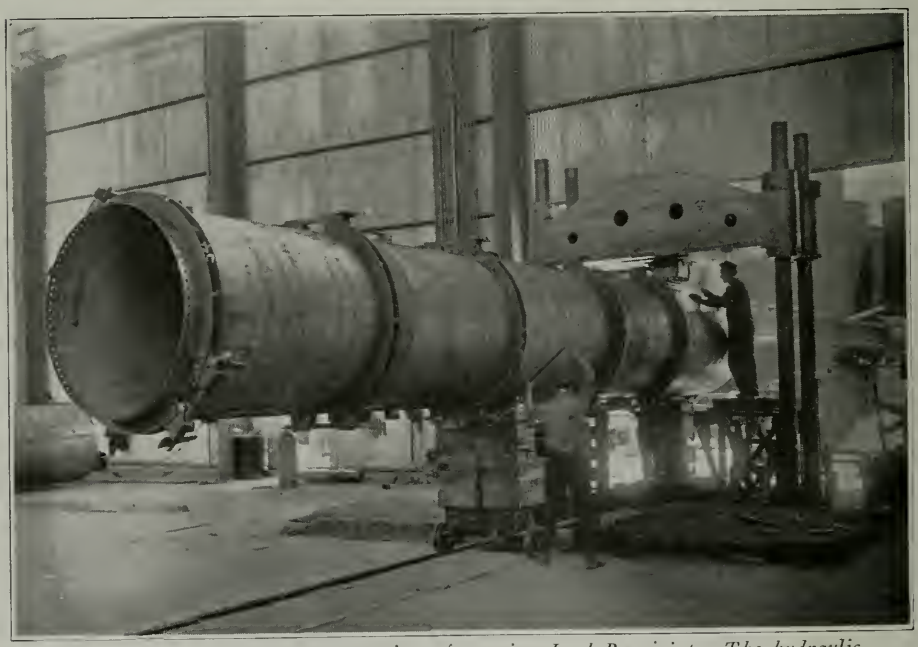
The steel plates were immediately ordered from the mills in the East, and the first began to arrive at the South San Francisco factory of Western Pipe and Steel Company during January, 1928. The field work started in the middle of February. During the months of February and March the work was held up by rain and got considerably behind schedule. At this writing the work has been speeded up, thanks to the cooperation of Western Pipe and Steel Company with Spring Valley Water Company, and it now appears that by July 1, 1928, San Francisco will be receiving water through the new 54-inch San Andres pipe line.

The Cover Picture

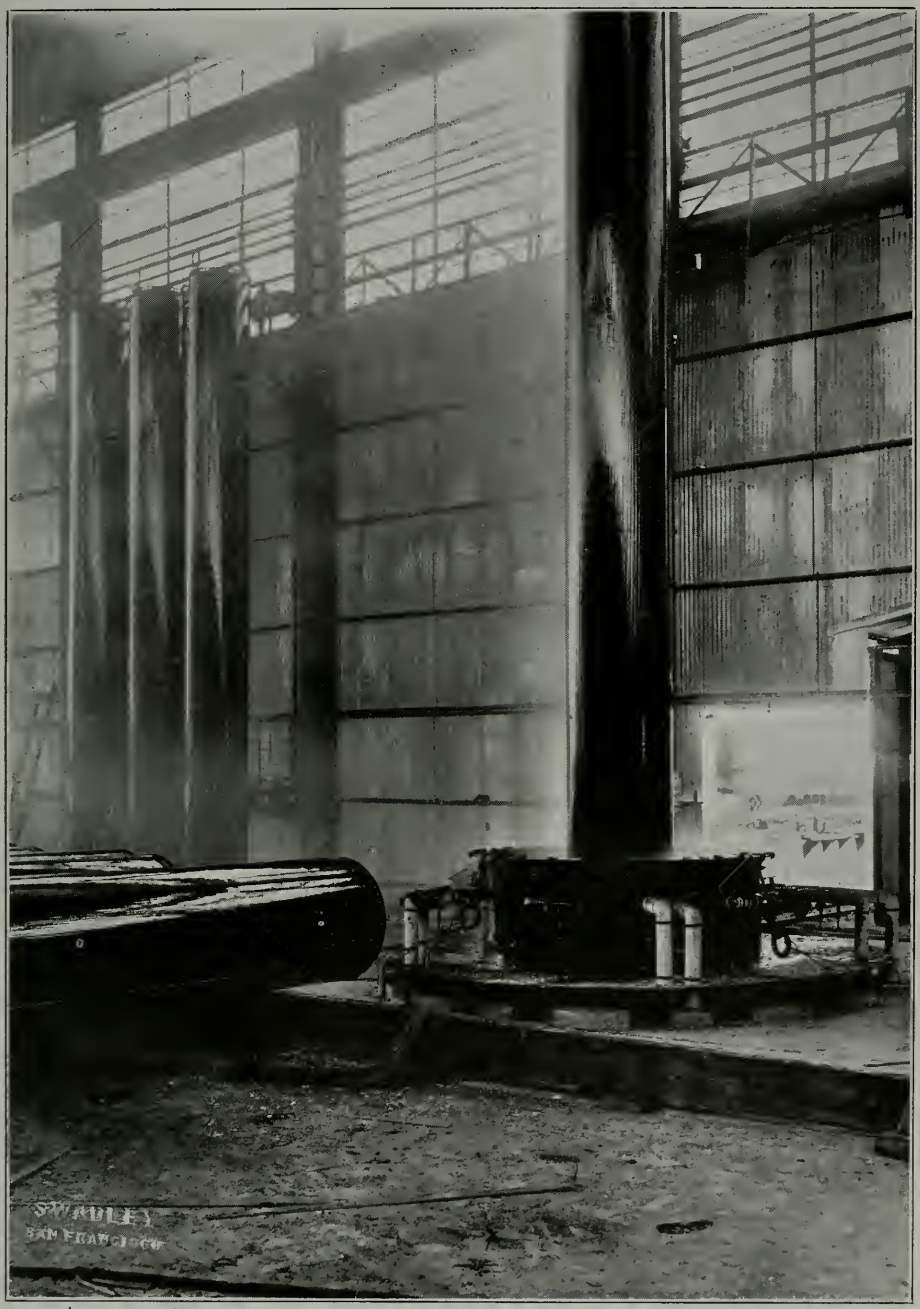
The picture on the front cover of this issue of Western Pipe and Steel News, shows a scene along Portola Drive in St. Francis Wood, one of San Francisco's finest residence districts, after the 54-inch lockbar steel pipe had been installed. Engineers will note at once the absence of the spoil bank. The material was trucked away as the trench was excavated, so as not to block the street, which is the main thoroughfare of the district.

As a result of this policy, there was practically no interruption of traffic at any time, much to the satisfaction of those who reside in this section of the city, as well as those who customarily use this street leaving and entering San Francisco.

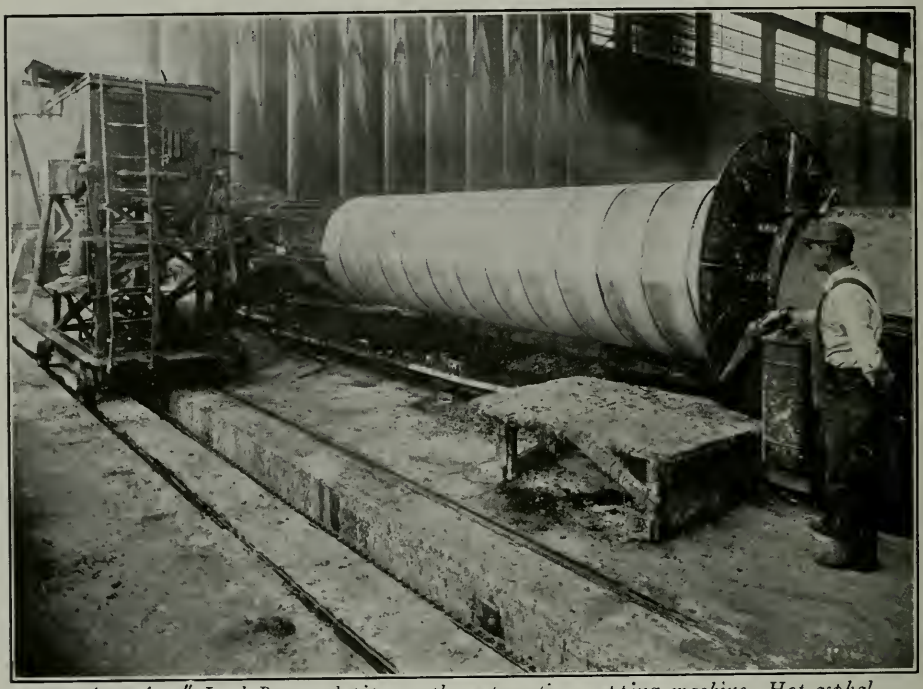
This view of Lock-Bar fabricating shows plate passing through rolls, two sections assembled, and section entering the hydraulic press.



The above view shows the operation of pressing Lock-Bar joints. The hydraulic press exerts a pressure of 350 tons on each bar.



A 30′ section of Lock-Bar pipe coming out of the dip kettle. Against the wall are three sections cooling, and on the runway are sections on their way to the wrapping machine to receive soil-proof covering.



Section of 54" Lock-Bar steel pipe on the automatic wrapping machine. Hot asphaltum compound flows between the wrapping and the pipe as it turns.

Picture taken through a section of 54" Lock-Bar pipe, showing smooth interior. The two Lock-Bar joints are plainly seen.

NEW SPRING VALLEY LOCK-BAR LINE CROSSING AN ARROYO NEAR LAKE MERCED GOLF AND COUNTRY CLUB.—*This is a part of the eleven mile transmission line, now nearing completion, which will add 30 million gallons daily to the present facilities, making it possible to bring 80 million gallons of water per day into San Francisco.*

Unquestioned Responsibility in Shop and Field

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Western Pipe & Steel Co.

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FACTORIES

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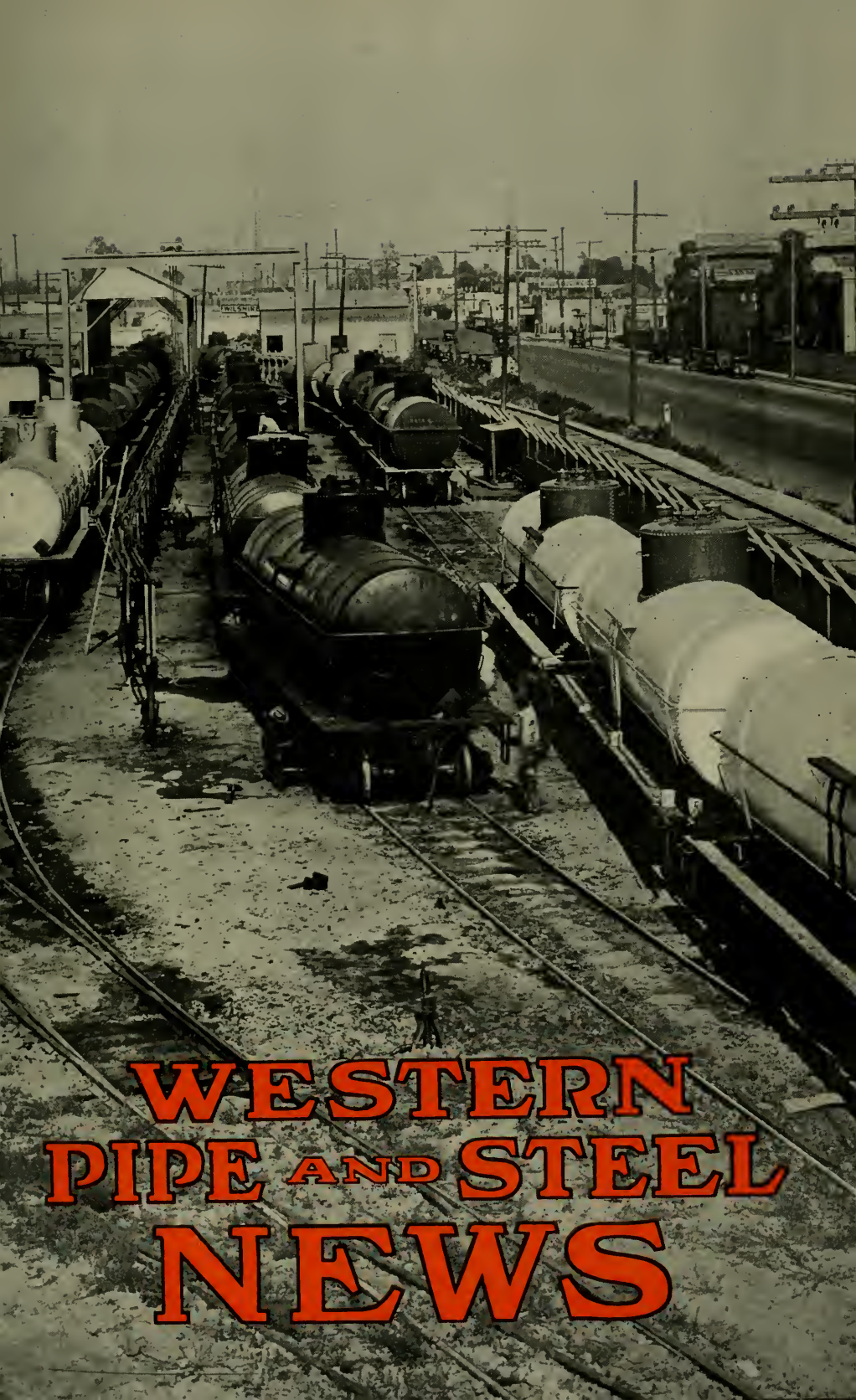
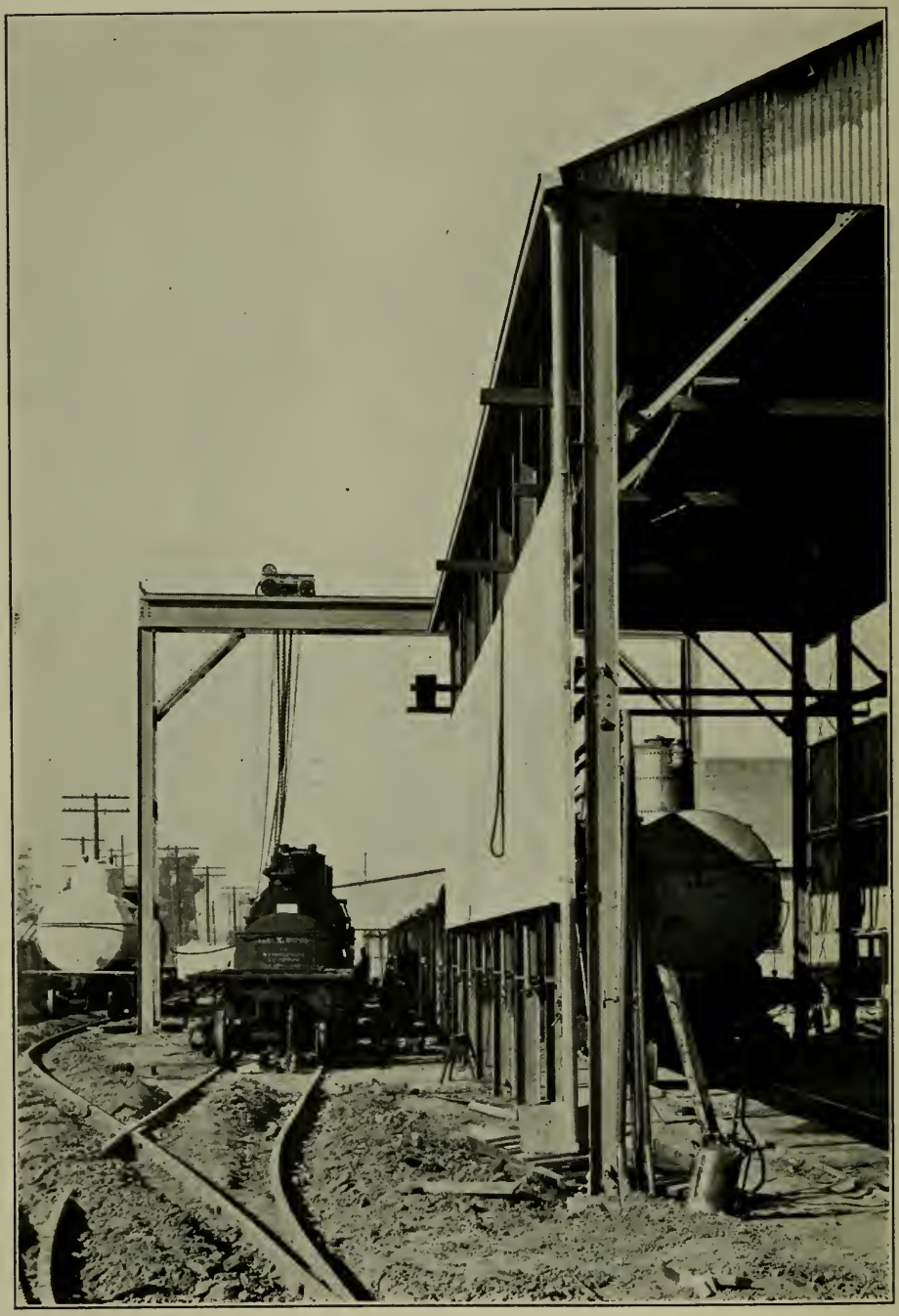

WESTERN
PIPE AND STEEL
NEWS



VIEW OF PAINT SHED, WESTERN TANK CAR COMPANY, LOS ANGELES.—*This new enterprise supplies a service to tank car owners that reduces to a minimum the time lost in repairing and repainting this class of rolling stock.*

Western Pipe and Steel News
PUBLISHED BY
WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA
SAN FRANCISCO , LOS ANGELES , FRESNO , TAFT , PHOENIX
VOLUME V JULY, 1928 NUMBER 6

Western Tank Car Company Solves Car Repair Problem with New Los Angeles Plant

A FEW months ago there was established at Los Angeles a plant that is revolutionizing the tank car repair business on the Pacific Coast. The name of this new concern is the Western Tank Car Company and behind it are combined the facilities of Western Pipe and Steel Company of California and the experience of the General American Tank Car Corporation, largest builders and lessors of tank cars in the world. The officials of the General American Tank Car Corporation, realizing the need of an up-to-date car repair plant on the Pacific Coast, made a thorough investigation some time ago of the situation. After looking over the facilities, equipment and organization of Western Pipe and Steel Company, they concluded that the logical step was to combine Western Pipe and Steel Company facilities with General American Tank Car Corporation experience, and to form a company controlled by the two.

The new plant of Western Tank Car Company is situated adjacent to the Los Angeles factory of Western Pipe and Steel Company of California and is served by both the Southern Pacific and the Santa Fe railroads. This location is fortunate, for it renders available Western Pipe and Steel Company's exceptional facilities for handling unusual repair work, thus enabling Western Tank Car Company to offer a far wider scope of service than perhaps any tank car repair company in this country. Spur track facilities to accommodate a great number of cars at one time have been installed and the plant has been so laid out as to insure prompt service and early return of equipment to owners.

That this plant fills a long-felt need goes without saying. Tank car owners, particularly the petroleum refining companies, were quick to take advantage of the new service offered them. In the past some of the larger oil companies have endeavored to solve their own tank car repair problems but the service of Western Tank Car Company has already proved so exceptional that most of them have come to depend upon it.

Time was when the problem of tank car repairs on the Pacific Coast was a serious and an aggravating matter with tank car owners. A "bad order" tank car is a total loss from the time it is taken out of service until it is returned repaired and repainted.

Formerly, tank car repair work was done for the owners by the different railroads. This involved serious delays, because no railroad could be expected to carry a stock of repair parts. Hence, tank cars stood inactive until repair parts could be shipped out from Chicago.

Western Tank Car Company has changed all this. There is no longer any need of long delays in tank car repair work. The company carries a large

stock of repair parts and regardless of the condition in which a tank car is received, it can be returned to service with a minimum of delay.

The company maintains an engineering department which stands ready to serve its customers at all times. Its inspection department, composed of experienced car repair men, will furnish estimates at any time without obligation to the car owner. There is also maintained a field crew for emergency repair work. This field crew may also be called upon for the work of grinding in outlet valves.

The equipment and facilities of Western Tank Car Company are such that if necessary it could build an entire new car including the tank. Underframes can be built to the specifications of any and every owner. The service offered includes the testing of tanks and safety valves; cleaning and repairing valves and triple valves; painting; changing head block cars to anchor type, etc.

Both the Western Pipe and Steel Company of California and the General American Tank Car Corporation appreciate the importance of this new enterprise and the possibility of rendering a service to tank car owners and operators that has long been needed. For this reason they stand back of Western Tank Car Company with all of their experience and facilities. A tank car taken out of service for repairs is a liability, but with the service now available the owner, instead of worrying about having his "bad order" cars out of commission from thirty to sixty days as was formerly the case, knows that now he can get prompt and expeditious repair work and that loss of time will be reduced to a minimum.

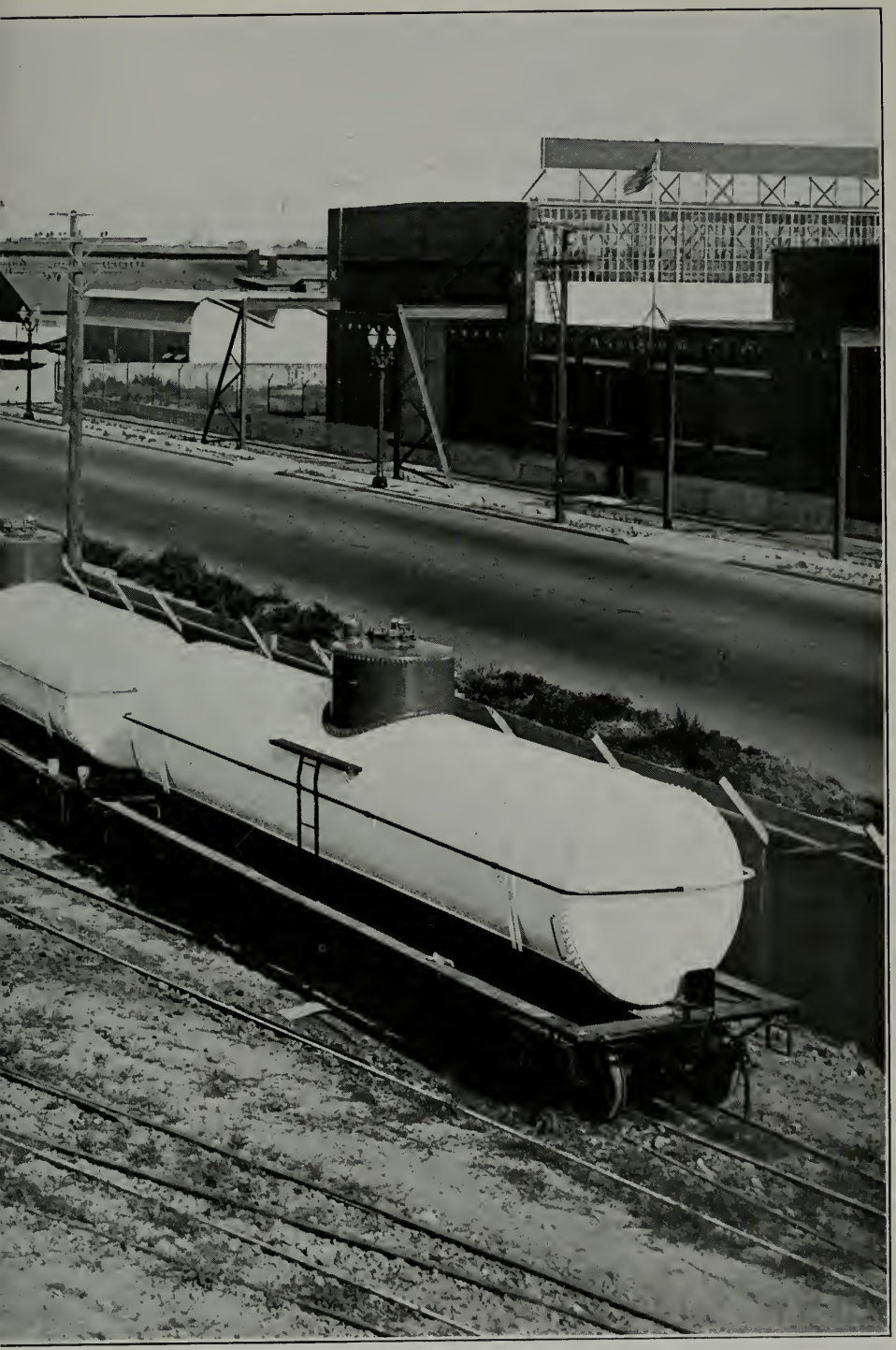
The sole object of Western Tank Car Company's organization is to keep tank cars rolling and that spirit has been infused into every employee of the company by Robert R. Weaver, Vice-President in charge of the Los Angeles plant.

"Bad order" tank cars on spur tracks at Los Angeles plant of Western Tank Car Company.

Tank car of Geo. H. Morrill Company after being repaired and repainted.

Bird's-eye view of new plant of Western Tank Car Company at Los Angeles.

GENERAL VIEW OF REPAIR YARD AND PLANT, WESTERN TANK CA
COMPANY, LOS ANGELES.—*This plant, devoted exclusively to the repair, repair*
ing and cleaning of tank cars, was opened only a few months ago. It has alread
proved itself a boon to tank car owners. Time lost on account of repairs has be



lnced from weeks to days and in some cases to a few hours because of the fact t a complete stock of repair parts of every description is always maintained. The nt adjoins the Los Angeles factory of Western Pipe and Steel Company at Santa and Slauson Avennes.

Western Pipe and Steel News

PUBLISHED BY
WESTERN PIPE AND STEEL COMPANY
of California
444 Market Street, San Francisco
5717 Santa Fe Avenue, Los Angeles

EDITED BY RICHARD PROSSER

This issue of Western Pipe and Steel News is devoted to the object of acquainting our readers with the facts regarding the organization, facilities and service of the Western Tank Car Company. This is a direct departure from the usual subject matter of this publication, which concerns itself ordinarily with the affairs of the Western Pipe and Steel Company of California, to the end that engineers, public officials, purchasing agents and other customers may be kept informed about the work handled by our five factories.

However, the entry of the Western Tank Car Company into the field and the importance of the service which it brings to tank car owners and operators has a news value that cannot be ignored.

There are several thousand readers of this magazine who are interested mainly in articles and illustrations pertaining to steel pipe and tanks, culverts and well casing, and the scores of other products in the fabrication of which this company leads the West. We must beg the indulgence of the many while presenting a subject of prime interest to the few. We have a great many readers who are interested in the production and transportation of petroleum products, ink, chemicals and so on, to whom the story of the Western Tank Car Company is good news.

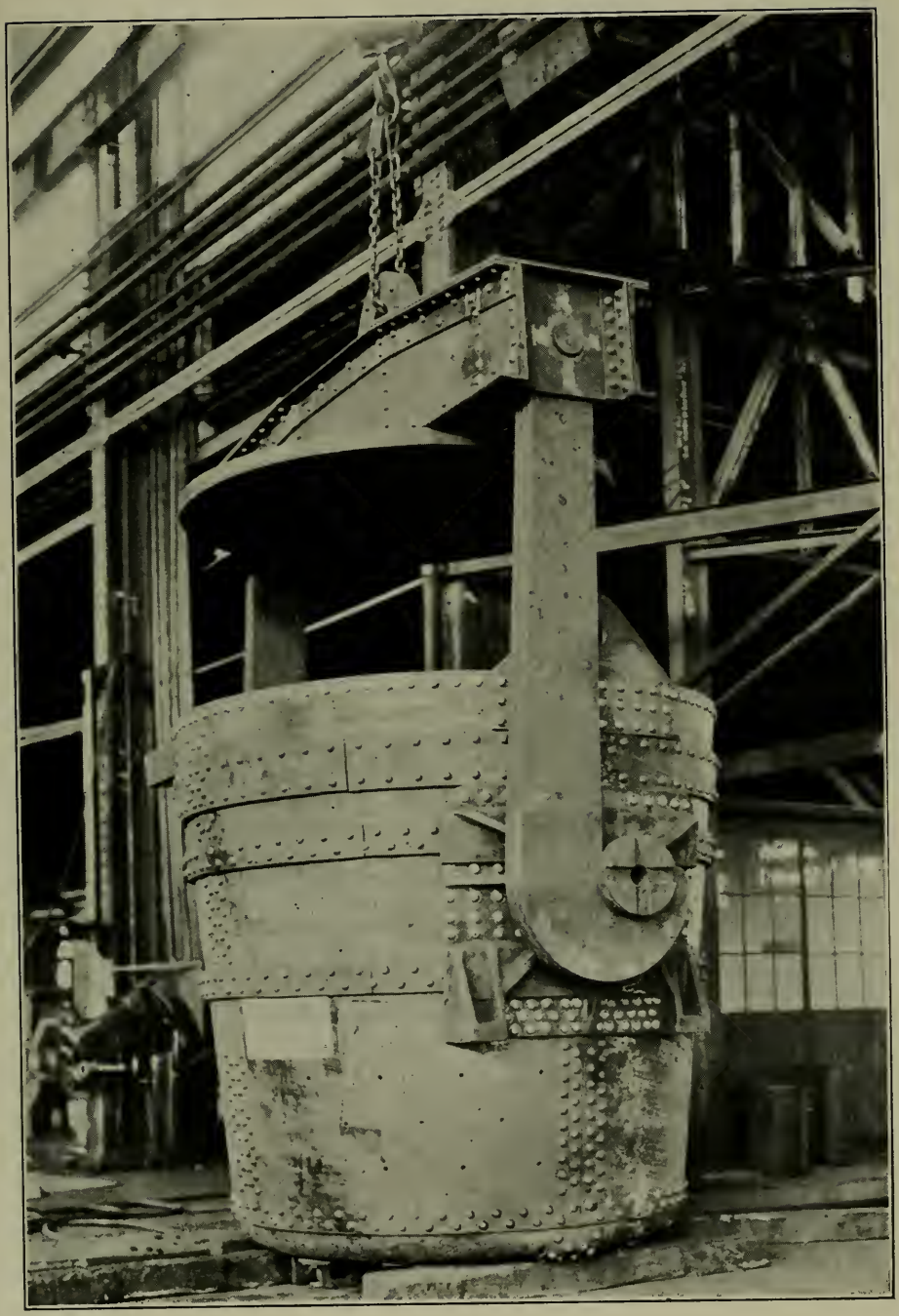
This story is set forth in our illustrations and in the article beginning on page one. It will be seen that the question of tank car repairing is reduced by the Western Tank Car Company from a matter of weeks and even months to a matter of hours or days.

A portion of the stock of car parts is seen above, at right of Western Tank Car Company's office.

Tank car of Western Oil & Refining Company after being repaired and painted.

Richfield Oil Company gasoline tank car ready to leave Western Tank Car Company's plant.

This picture shows a Trumble Gas Trap fabricated at our Los Angeles plant for Trumble Gas Trap Company. Oil industry equipment is a Western Pipe and Steel Company specialty.



THE STEEL LADLE PICTURED ABOVE IS A UNIQUE EXAMPLE OF RUGGED CONSTRUCTION.—*This ladle, fabricated for Pacific Coast Steel Company, has a capacity of 70 tons. It is approximately 11 feet in height and 8 feet in diameter. The bail is made of four steel plates 1 inch in thickness.*

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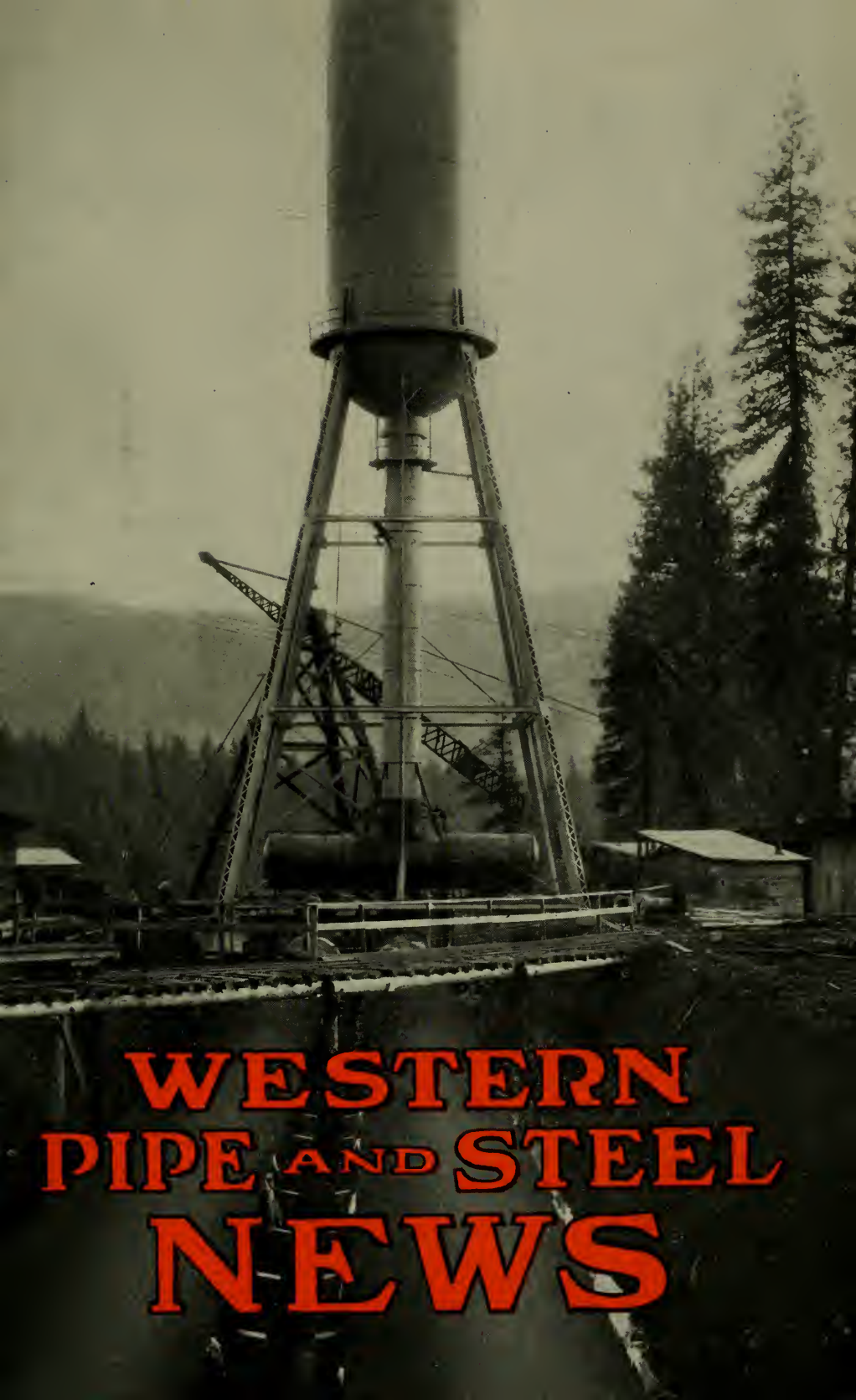


WESTERN PIPE AND STEEL NEWS

EXECUTIVE DEPARTMENT

SPRING VALLEY WATER COMPANY

425 MASON STREET

SAN FRANCISCO, CAL.

September 8, 1928.

Mr. Howard G. Tallerday,
Vice-President & General Manager,
Western Pipe & Steel Company,
444 Market Street,
SAN FRANCISCO.

Dear Sir:

Some nine months ago Spring Valley Water Company and the City of San Francisco finally agreed to an expansion program for the City's water supply.

Municipal problems of this character invariably involve delays. In this instance the agreement was made at a date so late as to jeopardize the adequacy of the City's water supply. Time had to be beaten.

Western Pipe & Steel Company was not only the lowest bidder for the high grade of work specified, but guaranteed the shortest time for construction. July 1, 1928 was the deadline and the contract called for the fabrication and installation of eleven miles of 54-inch diameter Lock-Bar steel pipe, with a capacity of thirty million gallons daily.

This is written in tribute to the fine record of accomplishment of your organization. The quality of the work fully met the specifications. It passed the rigid requirements of our Vice-President and Chief Engineer, George A. Elliott, the drastic inspection of his assistant, T. W. Espy, and the vigilant supervision of George W. Pracy, Superintendent of Distribution.

The work was finished and the water sent through the line on the deadline date of July 1. Contractor and owner fulfilled partnership obligations and met the urgent needs of a great city. We appreciate the integrity shown by your firm in fulfilling its contractual obligations, as well as the fine spirit of cooperation and the high degree of ability which your organization demonstrated throughout.

Yours truly,

President.

Western Pipe and Steel News
PUBLISHED BY
WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA
SAN FRANCISCO · LOS ANGELES · FRESNO · TAFT · PHOENIX
VOLUME V AUGUST-SEPTEMBER, 1928 NUMBER 7

Western Pipe and Steel Company of California Presents Some Specialities

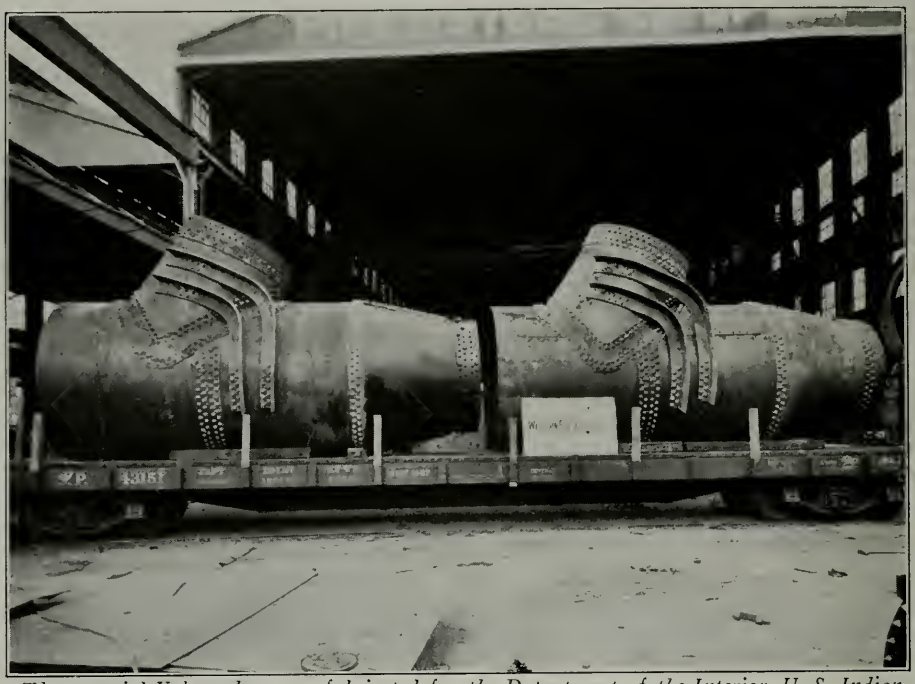
IT IS only natural that an organization operating five factories for the fabrication of steel products, and serving the entire Pacific slope, should, in addition to its better known lines, be called upon to turn out special orders of every description. Work of this special character is, in fact, constantly going through our plants. Having always been in accord with the axiom that "illustration beats explanation," we keep a photographic record of all work. To share this pictorial record of interesting products with our customers is one of the major functions of WESTERN PIPE AND STEEL NEWS.

We do it in this manner because to expect even a small proportion of those who purchase steel products from us to visit our factories often enough to keep in touch with what we are doing and how we are equipped, would be like asking the mountain to come to Mahomet. To continue the simile, this magazine, we feel, serves to bring our readers to the mountain.

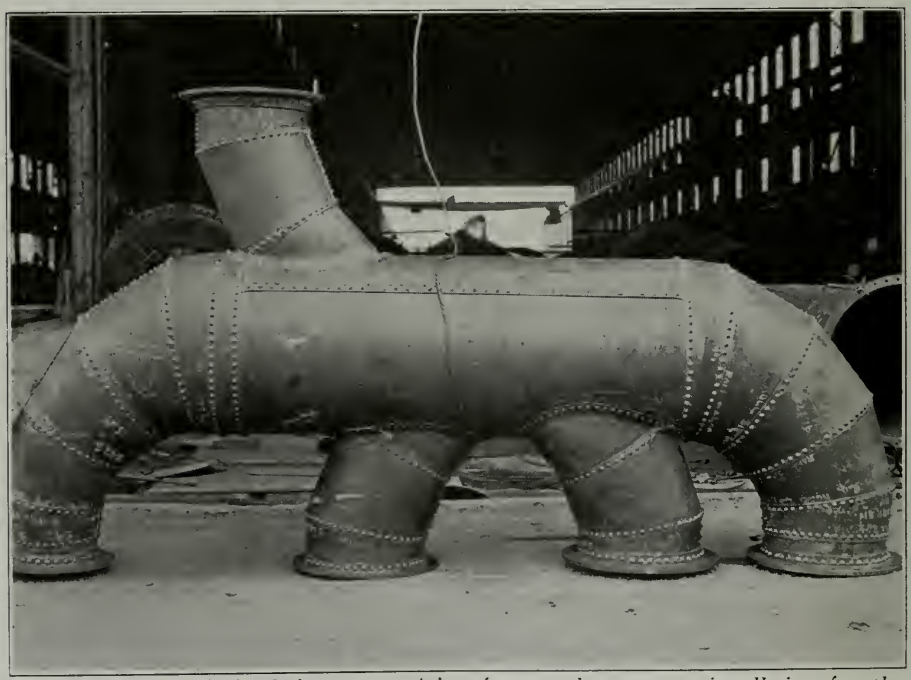
Since the purpose of this number is to cover as wide a range of special work as possible, text takes a subordinate role while pictures predominate. It should be borne in mind that because of the natural limitations of our publication, there are scores upon scores of pictures of special work that have had to be omitted. In other words, the operation of preparing this number was a purely selective one with the two-fold object of showing widely differing specimens of work which in turn would, by their very difference, emphasize the versatility of our facilities.

A point that is worth stressing is that the pictures presented here represent *current* work and they may fairly be taken as good average illustrations of what may be seen in our factories almost every day. Furthermore, those familiar with the different types of equipment which we operate will understand that by reason of the versatility of modern machine tools and appliances, we can and do manufacture a far greater variety of products than is indicated by the limited number of pictures it is possible to show within the compass of these pages.

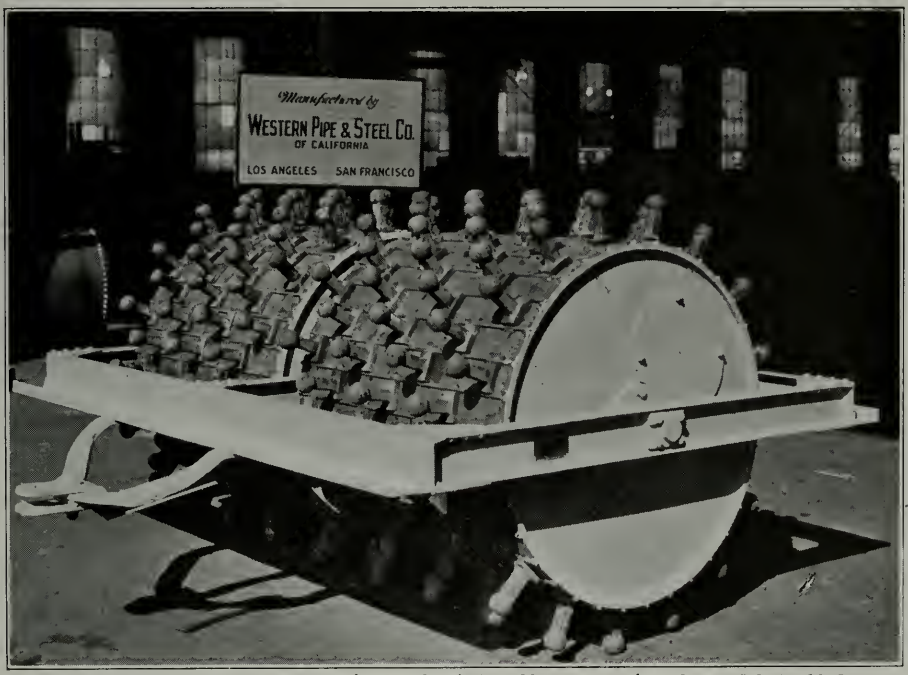
We refer, of course, to the adaptability of modern equipment to different functions, a matter which involves no little originality in shop practice. We believe that this kind of originality has played a very important part in the remarkable business in specialties which this company has built up. As a matter of fact, we have been credited with a great deal of pioneering along this line, pioneering that has resulted in economies of fabrication that have passed directly to our customers.



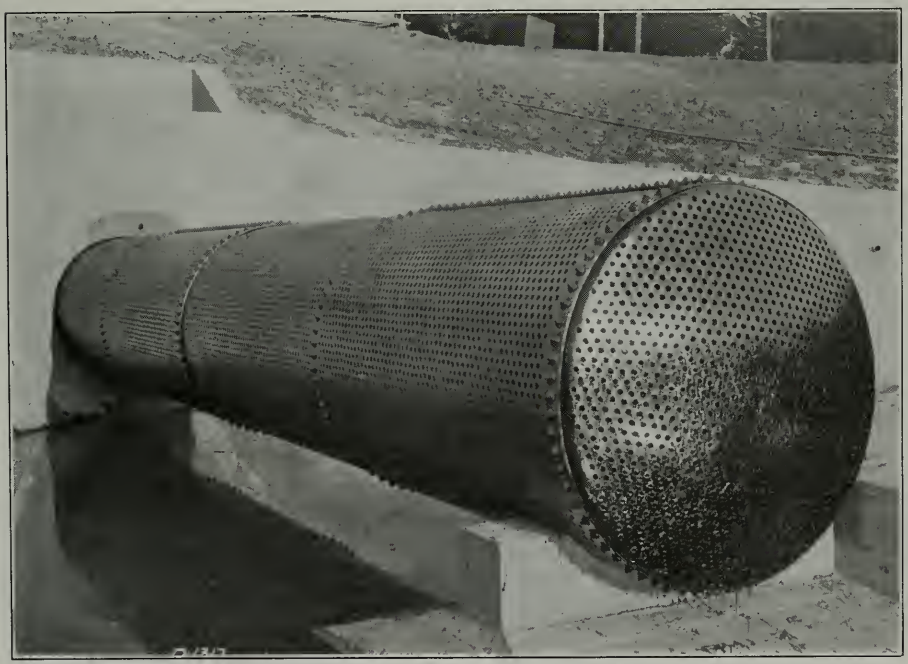
These special Y branches were fabricated for the Department of the Interior, U. S. Indian Irrigation Service, Coolidge Dam project, San Carlos, Ariz. They are 96" dia. x 72".



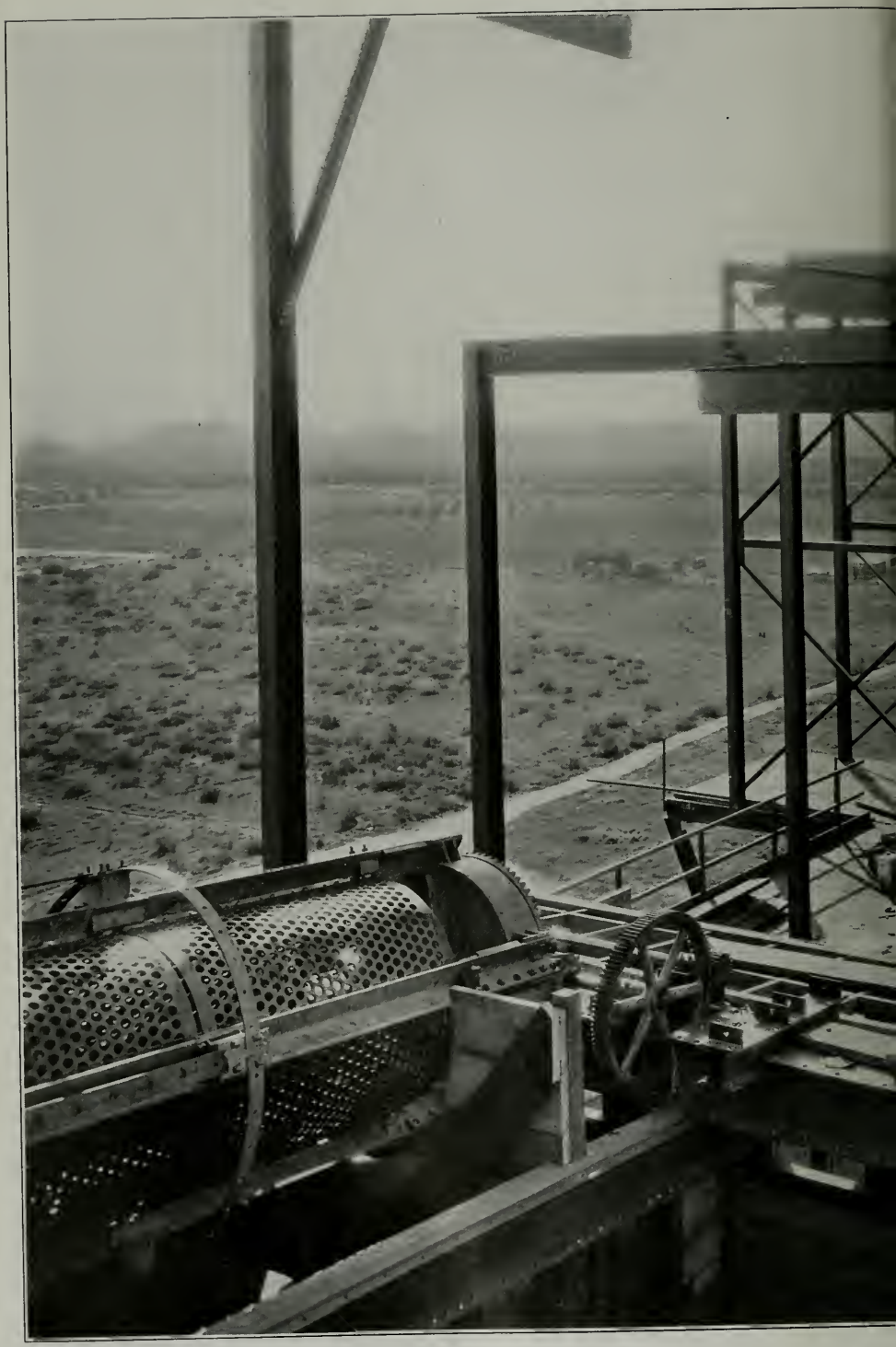
Manifold detail of circulating water piping for a turbo-generator installation for the Nevada Consolidated Copper Co., Hurley, N. M. It is 15' over all and 7' 7½" high.



Our Los Angeles plant manufactured this "Rohl" tamper for the H. W. Rohl Co., contractors.



One of several inlet screens fabricated for Spring Valley Water Company of San Francisco and installed at the Lake San Andres reservoir.



THIS PICTURE WAS TAKEN DURING THE ERECTION OF THE CALIFORNIA
TERIALS COMPANY'S PLANT AT BALDWIN, CALIFORNIA.—*Practically all of the*
terial and equipment seen here were furnished by Western Pipe and Steel Company's Los An

lant. The perforated rock screens, the structural steel and galvanized corrugated tank in the upper right-hand corner of the picture are all Western Pipe and Steel Company products. This is an unusually striking demonstration of the wide range of our manufacturing activities.

Western Pipe and Steel News

PUBLISHED BY
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444 MARKET STREET, SAN FRANCISCO
5717 SANTA FE AVENUE, LOS ANGELES
EDITED BY RICHARD PROSSER

As a general thing WESTERN PIPE AND STEEL NEWS is devoted to describing and picturing some outstanding project or development that in our judgment would be of interest to all our readers.

But ever so often there comes a time when it seems appropriate to cover another phase of our manufacturing activities, the "specialties."

Western Pipe and Steel Company is constantly called upon to execute special work from special design. In fact, so large a volume of our business comes under this head, that it might be said the bulk of the work fabricated in our five factories is of this special character.

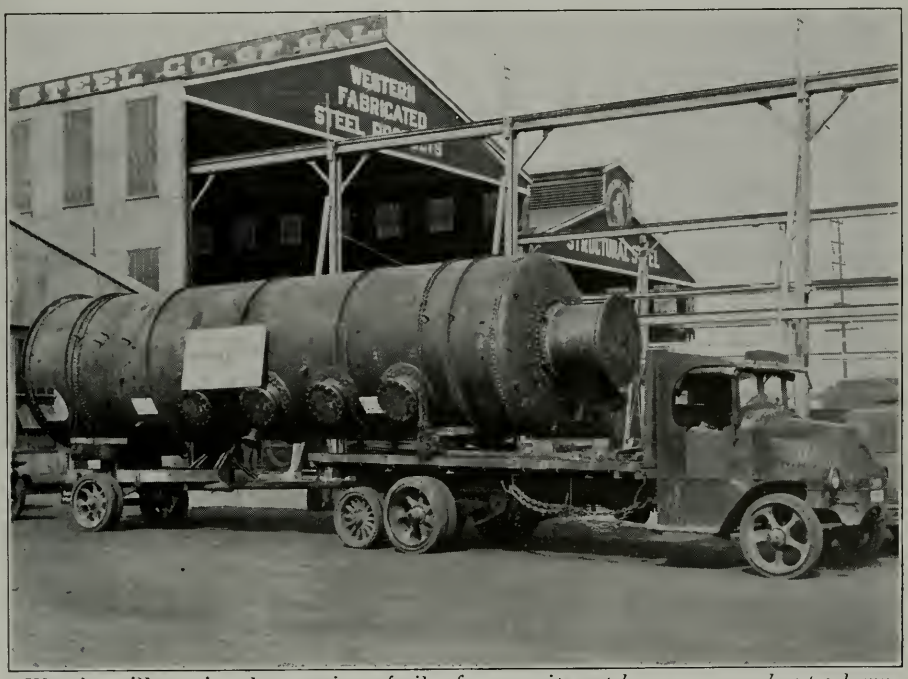
Those who are in the market, whether regularly or only occasionally, for products fabricated from steel, can gain a much better idea of the broad range of our facilities and our versatility as manufacturers from the special products illustrated herein, than they could even by periodical visits to our several factories.

We believe that with our experience and equipment, backed by technical knowledge, we are in a position to execute orders for any product fabricated from steel sheets, plates or structural material, for practically every purpose.

Those who think of Western Pipe and Steel Company principally as manufacturers of steel tanks, pipe, penstocks and siphons, will note from the illustrations in this number that our field is much wider.

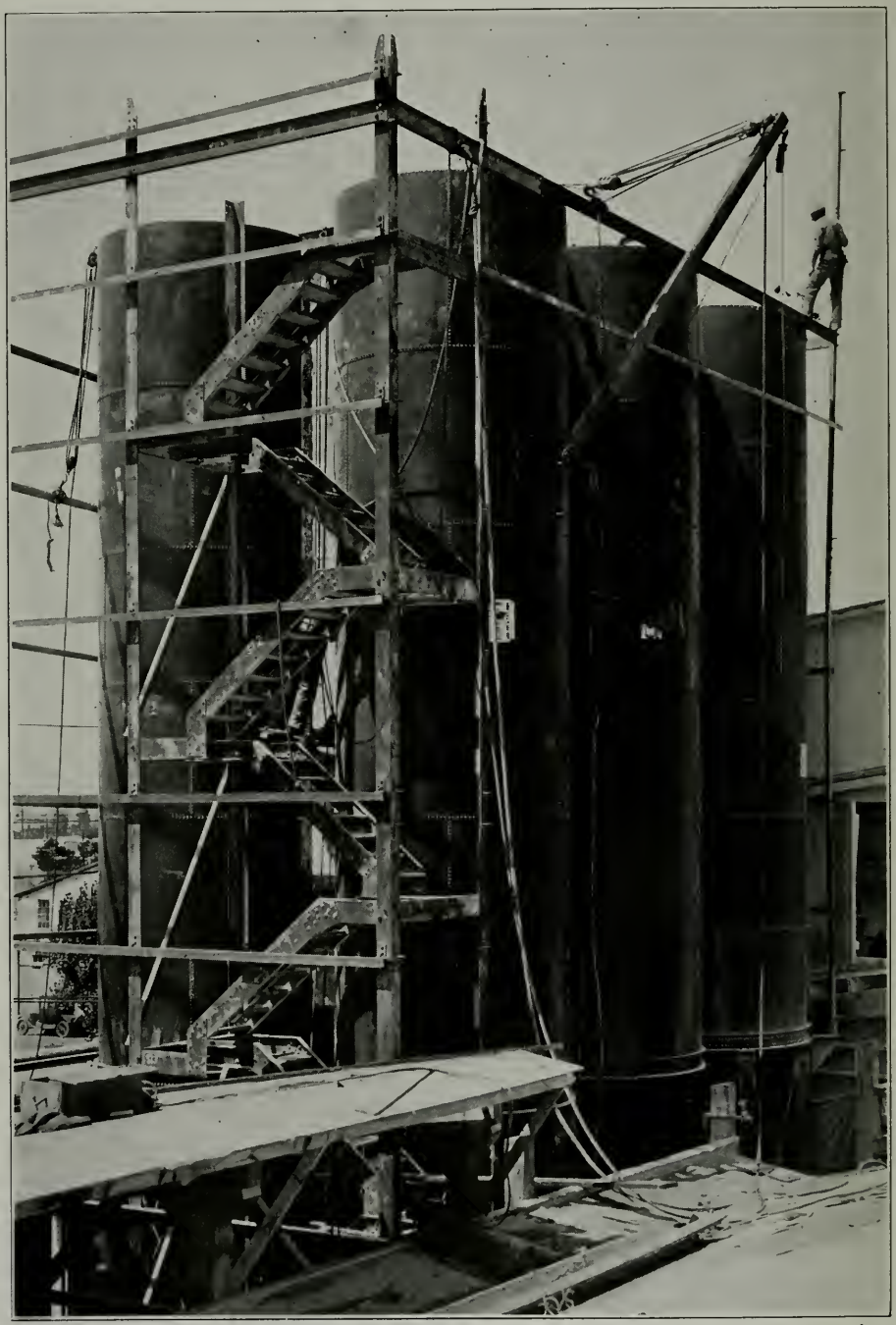
THE COVER PICTURE—Surge tank and cross reservoir, California-Oregon Power Company, Hydro-electric Development, Prospect No. 2.

Sections of draft pipe fabricated at our Los Angeles factory for California Portland Cement Company.



The above illustration shows a piece of oil refinery equipment known as an exhaust column, manufactured for the Union Oil Company.

This picture, taken at our Los Angeles plant, shows a carbon dioxide cooler, fabricated for the Inyo Chemical Company.



Installation of steel gypsum bins manufactured by Western Pipe and Steel Company for Schumacher Wallboard Co., Los Angeles.

THIS COMPANY HAS FABRICATED BOILER BREECHINGS FOR HUNDREDS OF STEAM PLANTS ON THE PACIFIC COAST.—*The breeching pictured above was made at our Los Angeles factory for the Southern California Edison Company's steam plant at Long Beach.*

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WESTERN PIPE AND STEEL NEWS

In This Issue:

New Standard Specifications of American Petroleum Institute for Steel Tanks

This night picture shows Western Pipe and Steel Company field crew erecting bolted tanks on an emergency order

AMERICAN PETROLEUM INSTITUTE
250 PARK AVENUE
NEW YORK

DIVISION OF STANDARDIZATION
1508 KIRBY BUILDING
DALLAS, TEXAS

DALLAS, TEXAS

October 10th, 1928.

Western Pipe & Steel Company of California,
444 Market Street,
San Francisco, California.

Gentlemen:

We acknowledge your telegram requesting ten copies of A.P.I.Stds. 12-A, First Edition, which we are enclosing herewith, together with our invoice therefor.

It is entirely satisfactory for you to republish these specifications in your magazine in whole or in part should you desire to do so, except, of course, permission cannot be granted for you to republish the official publication stamp that appears on the front cover page as this can only appear on specifications officially issued by the Institute. I am sure you will appreciate the reason for this.

When republishing these specifications in whole or in part, we offer the suggestion that you always refer to the standards number and the edition number. As you know, these specifications are liable to be amended and revised from time to time, in which case another edition number and date is given.

We agree with you that the republishing of these specifications in whole or in part will be of assistance in extending knowledge about the work.

Yours very truly,

C. A. Young,
Director

CAY-rp
Encl.

Western Pipe and Steel News
PUBLISHED BY
WESTERN PIPE AND STEEL COMPANY OF CALIFORNIA
SAN FRANCISCO · LOS ANGELES · FRESNO · TAFT · PHOENIX
VOLUME V OCTOBER, 1928 NUMBER 8

New Standard Specifications of American Petroleum Institute for Steel Tanks

Every thinking man appreciates that one of the great achievements of Herbert Hoover as Secretary of Commerce, was his success in bringing about the standardization and simplification of manufacturing methods, processes, and materials in American industry. There is scarcely an industry large or small, of whatever character, that has not received the benefits of Mr. Hoover's campaign for economy through standardization. The petroleum industry and the manufacturers serving that industry now have the benefit of the intensive work that has been carried on over a long period of time by the Division of Standardization of the American Petroleum Institute, with the co-operation of farsighted manufacturers, which has resulted in standard specifications for steel tanks for oil storage.

These specifications were adopted by the Division of Standardization of the Institute nearly a year ago; were amended at the meeting of the Special A. P. I. Committee on Standardization at Colorado Springs last June, and have just been published for members by the American Petroleum Institute.

Ralph J. Reed of the Union Oil Company of California, Los Angeles, is National Chairman of the A. P. I. Special Committee on Standardization of Steel Tanks for Oil Storage, and Mark W. Daw, of the Shell Company of California, San Francisco, is National Secretary. In an article discussing the work of the Committee, Mr. Reed and Mr. Daw had the following to say:

"The adoption of the recommended standard tank designs will bring the same advantages that result in other lines from efforts toward standardization or 'simplification,' as Mr. Hoover prefers to call it. In addition to minimizing the plate stock required, the existence of detailed standard designs will greatly simplify the process of ordering tanks. It will not be necessary for the purchaser asking for proposals for 'A. P. I. Standard Tanks' to prepare his own detailed plans, or check those submitted by the bidders. As the manufacturer will know definitely what is required of him he can prepare his bids quickly. His success in securing the order will then depend entirely upon price, workmanship and time of delivery, rather than the possibility of having a competitor persuade the customer to accept an inferior tank at a lower price.

"All of these advantages are sure to enable the user to save money on his tank construction and at the same time allow a satisfactory profit to the builder. Knowing that the majority of customers will buy tanks of the same design, the shops can fabricate parts during dull periods, and be assured of a sale when the demand increases. Labor-saving machinery can be installed without the necessity of resetting to meet the whims of each buyer. Stocks of steel can be reduced and when the shop must go beyond its own stock it will be easier to secure plates that will fit."

A. P. I. STDS. NO. 12-A.
First Edition—July, 1928.

A. P. I. Specifications for Standard Tanks With Riveted Shells

Adopted by the Board of Directors of the American Petroleum Institute December 8, 1927.
(These specifications were amended in June, 1928.)

FOREWORD:

(*a*) These specifications were prepared by the Special A. P. I. Committee on the Standardization of Steel Tanks for Oil Storage, and are recommended for the use of the oil industry in all districts of the United States.

(*b*) The specifications are designed to provide the industry with tanks of adequate safety and reasonable economy with a sufficient range of sizes to cover usual operating requirements; so designed that the entire range of sizes can be built with a minimum number of plate sizes; and with details conforming with modern manufacturing practice.

(*c*) The detailed drawings in Appendix D (bound separately) [obtainable from A. P. I. Division of Standardization, 1508 Kirby Bldg., Dallas, Texas], provide working designs in accordance with the specifications. These should be a convenience and economy to tank users.

The following table shows the range of capacities that can be obtained using only seven different diameters and varying the height:

Table 1—Tank Sizes

Capacities are in 42-gallon barrels; tank approximately level full.

DIAM.*	NOMINAL HEIGHT**				
	23½′ (Four courses)	29½′ (Five courses)	35′ (Six courses)	40½′ (Seven courses)	46′ (Eight courses)
36′	4300	5400	6400	7400	8400
48′	7600	9500	11300	13200	15000
60′		15000	17500	20500	23500
78′		25000	30000	35000	39500
102′		42500	51000	59000	68000
120′		59000	70000	82000	93000
144′		85000	101000	118000	134000

*Diameter inside of Course 2 of 8 course tank.

**Heights shown are approximate. See detailed drawings for exact heights of different sizes.

PART 1.

Design Specifications

SECTION 1.

MATERIAL (The principal provisions of the specifications covering materials to be used are included in Appendix A, Tables 5 and 6). (See Page 7 for Table 5. See Page 12 for Table 6.)

1. The various materials used shall conform in chemical and physical properties to the following specifications:

2. PLATES.
   Either Class "A" Association of American Steel Manufacturers, or
   Current A.S.T.M.A.-7, or
   Current A.S.T.M.A.-9 (Open hearth steel only).

3. Copper-bearing steel may be used for roof plates if so specified by the purchasers.

4. Plate specifications by weight is recommended, and plates purchased on weight specifications shall individually comply with the normal tolerances as they appear in these specifications. (Where plates are referred to by thickness in the specification, or on the drawings, the thickness shall be considered as nominal only.)

5. STRUCTURAL STEEL.
   Current A.S.T.M.A.-9.

6. RIVETS FOR HOT DRIVING.
   Either Current A.S.T.M.A.-7, or
   Current A.S.T.M.A.-31, or
   A.S.M.E. Boiler Code.

7. RIVETS FOR COLD DRIVING.
   Rivets conforming to either of the above specifications, annealed.

If copper bearing steel is specified for the roof plates, the rivets shall contain the same percentage of copper.

SECTION 2.

Shell Design

LOADS AND WORKING STRESSES:

8. Stresses are to be computed on the assumption that the tank is filled level full of water at 60 degrees Fahr., and the tension in each ring is to be computed 12" above the bottom gauge line of the ring in question.

9. In computing net section of plate, rivet holes when punched 1/16-inch over nominal diameter for hot driven rivets, are to be assumed 1/8-inch larger than nominal diameter of the rivet; when punched 1/32-inch over nominal diameter for cold driven rivets, holes are to be assumed 3/32-inch larger than nominal diameter of rivet. When drilled, or when sub-punched and reamed, holes are to be assumed 1/16-inch larger in diameter than nominal diameter of rivet. The net section of rivet to be used for computing shear values should be, in the case of hot driven rivets, nominal diameter plus 1/16-inch; in case of cold driven, nominal diameter plus 1/32-inch.

10. All openings over four inches in diameter in the shell of the tank shall be reinforced. This reinforcement may be the flange of the fitting used, or an additional ring of metal, or both flange and ring.

11. The amount of reinforcement shall be determined in accordance with Paragraph 1 of Appendix "A," attached to these specifications.

12. The following maximum allowable working stresses shall be used in design:

MAXIMUM TENSILE STRESS IN NET SECTION OF PLATE:
21,000 lbs. per sq. in.

MAXIMUM SHEAR IN NET SECTION OF RIVET:
16,000 lbs. per sq. in.

MAXIMUM BEARING STRESS ON PLATES OR RIVETS:
35,000 lbs. per sq. in. when rivets are in double shear.
32,000 lbs. per sq. in. when rivets are in single shear.

SIZES OF PLATE AND TANK:

13. Tanks shall be designed so that the diameter is a multiple of six feet, using shell plates having a net length (total length minus lap) of 6 pi feet (6 times 3.1416). The number of plates in each course will thus be equal to the diameter of the tank divided by six. Shell plates shall have an overall width of 72".

14. The minimum thickness of shell plates shall be ¼" in tanks over 48 ft. in diameter; and shall be 3/16" in tanks 48 ft. or less in diameter.

15. Tanks shall be designed with vertical rings so that all plates will be truly rectangular. In tanks six rings high or less each ring shall be inside the one beneath it; in seven ring tanks the second ring shall be outside the first and each ring above the second shall be inside the one beneath it; and in eight ring tanks the second ring shall be inside the first, the third ring outside the second, and each ring above the third inside the one beneath it.

RIVETING:

16. The following combinations of rivet sizes and plate thicknesses are suggested:

3/16" Plate	7/16" Rivets
1/4" Plate	5/8" Rivets
5/16" Plate	5/8" Rivets
3/8" Plate	3/4" Rivets
7/16" Plate	3/4" Rivets
1/2" to and incl. 5/8" Plate	7/8" Rivets
Over 5/8" and incl. 3/4" Plate	1" Rivets
Over 3/4" and incl. 7/8" Plate	1⅛" Rivets

17. In round-about seams the same size of rivet shall be used as used in the vertical joint of the ring above.

18. Unless otherwise limited by considerations of stress, the minimum distance between centers of rivet holes shall be three times the nominal diameter of the rivet, and the maximum distance shall be seven times the thickness of the plate, plus the nominal diameter of the rivet.

19. The distance from center lines of rivets to the edges of plates and the allowance for bevel shearing or planing shall be as shown in Table 2. The distance between gauge lines of roundabout joints shall be exactly as found by deducting from 72" dimensions "C" for

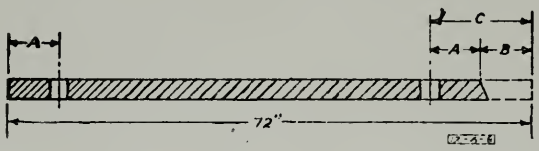

Figure 1.

TABLE 2—EDGE DISTANCES

See Figure 1.

(All Dimensions in Inches)

Plate Thickness	Rivet Diameter	(See Sketch Above) A	B	C
3/16	7/16	5/8	1/4	7/8
1/4	7/16	5/8	3/8	1
1/4	5/8	15/16	3/8	1–5/16
5/16	5/8	15/16	7/16	1–3/8
11/32	5/8	15/16	1/2	1–7–16
11/32	3/4	1–1/8	1/2	1–5/8
3/8	5/8	15/16	9/16	1–1/2
3/8	3/4	1–1/8	9/16	1–11/16
13/32	5/8	15/16	9/16	1–1/2
13/32	3/4	1–1/8	9/16	1–11/16
7/16	5/8	15/16	5/8	1–9/16
7/16	3/4	1–1/8	5/8	1–3/4
15/32	3/4	1–1/8	5/8	1–3/4
15/32	7/8	1–5/16	5/8	1–15/16
1/2	3/4	1–1/8	3/4	1–7/8
1/2	7/8	1–5/16	3/4	2–1/16
9/16	3/4	1–1/8	3/4	1–7/8
9/16	7/8	1–5/16	3/4	2–1/16
5/8	7/8	1–5/16	13/16	2–1/8
21/32	7/8	1–5/16	13/16	2–1/8
21/32	1	1–1/2	13/16	2–5/16
11/16	7/8	1–5/16	13/16	2–1/8
11/16	1	1–1/2	13/16	2–5/16
3/4	7/8	1–5/16	7/8	2–3/16
3/4	1	1–1/2	7/8	2–3/8
25/32	1–1/8	1–11/16	7/8	2–9/16
13/16	7/8	1–5/16	7/8	2–3/16
13/16	1	1–1/2	7/8	2–3/8
13/16	1–1/8	1–11/16	7/8	2–9/16
7/8	1	1–1/2	7/8	2–3/8
7/8	1–1/8	1–11/16	7/8	2–9/16

edges to be caulked and dimensions "A" for edges not to be caulked.

20. The distance between the center lines of any two adjacent rows of rivets or the "back pitch," measured at right angles to the direction of the joint, shall be determined in accordance with Paragraph P-182, A.S.M.E. Boiler Construction Code, edition of 1924. (This paragraph is copied in Paragraph 1, Appendix "A" attached to these specifications.)

21. The top angle shall be placed on the inside of the shell.

SECTION 3.

Roof Design

22. Conical steel roof and supporting structure shall be designed to carry a live load of 25 lbs. per sq. ft. in addition to the dead load, and the supporting structure shall be designed in accordance with current American Institute of Steel Construction "Standard Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings," except that the value of L/R shall not exceed 180. Structural shapes shall be used for roof columns. The slope of the roof shall be ½-inch in twelve inches.

23. Roof plate shall be 3/16" thick, 72" wide and shall have the same approximate length as 3/16" shell plates. They may be either riveted or welded; if riveted, rivets shall be 7/16" @ 1½" pitch.

24. Rafters are to be spaced so that in the outer row there shall be not less than three rafters to each shell plate; spacing on inner rows is not to be greater than 5½ feet.

SECTION 4.

Bottom Design

25. All rectangular bottom plates shall be ¼" thick, 72" wide, and shall have the same approximate lengths as ¼" shell plates.

26. Bottom sketch plates in tanks over 48 feet in diameter shall be 5/16" thick and 72" wide. Sketch plates in tanks 48 feet in diameter and less shall be ¼" thick and 72" wide.

27. Bottom rivets shall be ⅝" in diameter.

SECTION 5.

Marking

28. Tanks with riveted shells manufactured in accordance with these specifications shall be identified by a special nameplate..... bearing the A. P. I. monogram. Size of monogram on nameplate shall be ½" high,..... Authority to use the monogram will be granted to any manufacturer, in accordance with the rules and regulations laid down in Appendix "C."

PART II.

Fabrication Specifications

29. All work of fabricating A. P. I. Standard Tanks shall be done in accordance with the plans accompanying these specifications. The workmanship and finish shall be first-class in every respect, subject to the closest inspection.

30. Straightening of material shall be done before being laid out or worked on in any way and by methods which will not injure it. Heating or hammering will not be permitted.

31. Laying out shall be done by experienced workmen only. Rivet holes shall be accurately spaced so that they come opposite each other in adjoining parts.

32. Punching: All plates (except roof plates when a welded roof is ordered) shall be punched before being bevel-sheared, planed or rolled. All punched and reamed holes shall be clean-cut without torn or ragged edges. The diameter of the punch shall be the same as the nominal diameter of the hole. The diameter of the die shall not be less than 1/32-inch or more than 1/16-inch larger than the diameter of the punch.

33. Rivet Holes: Where rivets are to be driven hot, finished diameter of the holes shall be 1/16-inch larger than nominal diameter of rivet; where rivets are to be driven cold, finished diameter of holes shall be 1/32-inch larger than nominal diameter of rivet. In plates ⅝-inch thick and under, holes may be either punched to finished diameter, sub-punched and reamed to finished diameter, or drilled. In plates over ⅝-inch thick, rivet holes shall be either drilled or sub-punched at least

(Continued on Page 9)

Riveted Tank Specifications

TABLE 4—DESIGN DETAILS

Diameter		36′	48′	60′	78′	102′	120′	144′
Capacity—42 gal. Bbls. Total of Highest Tank		8400	15000	23500	39500	68000	93000	134000
Shell Courses	Number of Sheets per Shell Course	6	8	10	13	17	20	24
8 (Top)	Thickness of Plate	3/16″	3/16″	1/4″	1/4″	1/4″	1/4″	1/4″
	Riveting	7/16″ L1	7/16″ L1	5/8″ L1	5/8″ L1	5/8″ L1	5/8″ L1	5/8″ L1
	Rivet Pitch	1.5″	1.5″	2.05″	2.05″	2.05″	2.05″	2.05″
7	Thickness of Plate	3/16″	3/16″	1/4″	1/4″	1/4″	1/4″	5/16″
	Riveting	7/16″ L1	7/16″ L1	5/8″ L1	5/8″ L1	5/8″ L2	5/8″ L2	5/8″ L2
	Rivet Pitch	1.5″	1.5″	2.05″	2.05″	2.375″	2.375″	2.565″
6	Thickness of Plate	3/16″	1/4″	1/4″	1/4″	5/16″	11/32″	13/32″
	Riveting	7/16″ L1	5/8″ L1	5/8″ L2	5/8″ L2	5/8″ L2	5/8″ L3	3/4″ L3
	Rivet Pitch	1.5″	2.06″	2.375″	2.375″	2.565″	3.0″	3.59″
5	Thickness of Plate	1/4″	1/4″	1/4″	5/16″	13/32″	7/16″	15/32″
	Riveting	5/8″ L1	5/8″ L2	5/8″ L2	5/8″ L2	3/4″ L3	3/4″ L4	3/4″ B3
	Rivet Pitch	2.06″	2.375″	2.375″	2.565″	3.59″	3.8125″	7.1562″
	Thickness of Butt Straps Inside							5/16″
	Thickness of Butt Straps Outside							13/32″
4	Thickness of Plate	1/4″	1/4″	5/16″	3/8″	15/32″	15/32″	9/16″
	Riveting	5/8″ L2	5/8″ L2	5/8″ L2	3/4″ L3	3/4″ L4	3/4″ B4	7/8″ B4
	Rivet Pitch	2.375″	2.375″	2.565″	3.375″	4.0″	14.3125″	16.5
	Thickness of Butt Straps Inside						11/32″	13/32″
	Thickness of Butt Straps Outside						13/32″	15/32″
3	Thickness of Plate	1/4″	5/16″	11/32″	7/16″	1/2″	9/16″	11/16″
	Riveting	5/8″ L2	5/8″ L2	5/8″ L3	3/4″ L3	7/8″ B4	7/8″ B4	1″ B4
	Rivet Pitch	2.375″	2.565″	3.00″	3.59″	16.5″	16.5″	18.42″
	Thickness of Butt Straps Inside					3/8″	13/32″	1/2″
	Thickness of Butt Straps Outside					15/32″	15/32″	17/32″
2	Thickness of Plate	5/16″	11/32″	13/32″	15/32″	9/16″	5/8″	25/32″
	Riveting	5/8″ L2	5/8″ L3	3/4″ L3	3/4″ B3	7/8″ B4	7/8″ B5	1 1/8″ B4
	Rivet Pitch	2.565″	3.00″	3.59″	7.1562	16.5″	16.625″	20.75″
	Thickness of Butt Straps Inside				5/16″	13/32″	15/32″	5/8″
	Thickness of Butt Straps Outside				13/32″	15/32″	15/32″	5/8″
1 (Bot)	Thickness of Plate	5/16″	3/8″	15/32″	1/2″	5/8″	3/4″	7/8″
	Riveting	5/8″ L2	3/4″ L3	3/4″ L3	7/8″ B4	7/8″ B5	1″ B4	1 1/8″ B5
	Rivet Pitch	2.565″	3.375″	3.4″	16.5″	16.625″	18.42″	22.00″
	Thickness of Butt Straps Inside				3/8″	15/32″	9/16″	5/8″
	Thickness of Butt Straps Outside				15/32″	15/32″	9/16″	11/16″
Top Angles		2 1/2″x2 1/2″x 5/16″	2 1/2″x2 1/2″x 5/16″	2 1/2″x2 1/2″x 5/16″	3″x3″x3/8″	3″x3″x3/8″	3″x3″x3/8″	3″x3″x3/8″
Bottom Angles		3″x3″x3/8″	3″x3″x3/8″	3″x3″x3/8″	4″x4″x1/2″	4″x4″x5/8″	4″x4″x5/8″	4″x4″x5/8″
Bottom Rectangular Plates		1/4″	1/4″	1/4″	1/4″	1/4″	1/4″	1/4″
Bottom Sketch Plates		1/4″	1/4″	5/16″	5/16″	5/16″	5/16″	5/16″
Bottom Rivets		5/8″	5/8″	5/8″	5/8″	5/8″	5/8″	5/8″

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TABLE 5.

PRINCIPAL PROVISIONS OF MATERIALS SPECIFICATIONS LISTED IN SECTION I.

For Details See Texts of Specifications Referred To.

USE	SPECIFICATION	PROCESS of MANUFACTURE	CHEMICAL PROPERTIES			PHYSICAL PROPERTIES				
			Phosphorus (Not over)	Sulphur (Not over)	Manganese	Tensile Strength	Yield Point	Elongation—% In 2"	Elongation—% In 8"	Bend Test
Plates	Class A Assoc. of Am. Steel Mfgs.	Open Hearth	Acid —.06* Basic—.04*	.06*		55,000-65,000	.5 Tensile Strength	22	1,400,000† / Ten. Str.	3/4" and under—cold bent 180° flat on itself. Over 3/4" to 1-1/4"—cold bent around a pin whose diameter is plate thickness.
Plates	A-7 A. S. T. M.	Open Hearth	Acid—.06* Basic—.04*	.05*		55,000-65,000	.5 Tensile Strength Minimum 30,000	22	1,500,000† / Ten. Str.	do.
Structural Members; Plates	A-9 A. S. T. M.	Open Hearth **Bessemer	O.H.—.06* Bess.—.10*	.06*		55,000-65,000	.5 Tensile Strength Minimum 30,000	22	1,400,000† / Ten. Str.	do.
Rivets	A-7 A. S. T. M.	Open Hearth	.04*	.045*		46,000-56,000	.5 Tensile Strength Minimum 25,000		1,500,000† / Ten. Str.	Cold 180° flat on itself.
Rivets	A-31 A. S. T. M. and Boiler Code A. S. M. E.	Open Hearth	.04	.045	.30-.50	45,000-55,000	.5 Tensile Strength		1,500,000‡ / Ten. Str.	(1) Specimen cold bent 180° flat on itself. (2) Specimen heated to 1200° and quenched in water bent 180° flat on itself. (3) Rivet shank cold bent as above. Flattening Test (4) Rivet head shall flatten while hot to diam. 2-1/2 times shank diam.

*From ladle analysis made by manufacturer; check analysis from finished material by purchaser may show 25% more.
**Open hearth Steel only allowed for tank plates by A. P. I. Specifications 12-A.
†See exceptions listed in particular code.
‡Need not be over 30%.

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WITH the consent and approval of the Director of the Division of Standardization of the American Petroleum Institute, Mr. C. A. Young, we publish in this issue of WESTERN PIPE AND STEEL NEWS the new specifications covering steel tanks for the storage of oil. Just as this company conceived it to be its duty as well as its privilege to co-operate with the Standardization Committee of the American Petroleum Institute, we also deem it our duty as well as privilege to be as helpful as possible in broadcasting the results of the Committee's work.

When we telegraphed Mr. Young requesting authorization to republish the new specifications, we suggested to him that our circulation might aid materially in disseminating this most important information.

In his reply, Mr. Young phrased his endorsement of this thought as follows: "We agree with you that the republishing of these specifications in whole or in part will be of assistance in extending knowledge about the work."

In this connection we direct the special attention of our readers to the facsimile reproduction of Mr. Young's letter on the inside front cover of this number.

The editor desires to make acknowledgment here to Messrs. Ralph J. Reed, of the Union Oil Company of California, and Mark W. Daw, of the Shell Oil Company of California, National Chairman and National Secretary of the American Petroleum Institute's Special Committee of Steel Tanks for Oil Storage, and also to Director Young of the Division of Standardization, for their helpful co-operation, without which it would have been impossible for Western Pipe and Steel Company of California to present this important data.

The objective of the Standardization Committee has been described by Mr. Reed and Mr. Daw as follows:

"In the actual work of preparing the standards it proved desirable to adopt a standard plate size first. This selection was guided largely by the recommendations of tank manufacturers—since it has been the purpose of the committee throughout its work to design a series of tanks that would be economical both to fabricate and to erect in the field. A plate width of 72 inches was chosen because it is now used in many shops, is a common width of plate carried in stock by jobbers, and is the widest plate in which three-sixteenths inch or one-quarter inch thicknesses can be bought at base price. With a view to minimizing the number of vertical joints it was agreed that the longest plate which could be economically handled by the usual field erection equipment should be used. This was reported by the manufacturers to be in the neighborhood of 18 to 20 feet. The length finally adopted was approximately 19 feet; this length is 6 x 3.1416 (plus a small allowance for lap) so that the diameters of tanks built with these plates will vary by even multiples of 6 feet.

"With the size of the plate decided it was agreed that the industry's requirements for storage tanks could be readily met with a series of tanks of seven diameters ranging from 36 to 144 feet."

(Continued from Page 5)

⅛-inch less than finished diameter and reamed.

34. Caulking edges of plates ½-inch and less in thickness shall be beveled by shearing or planing, the angle of bevel to be not less than 65° nor more than 75°. On plates over ½-inch thick, caulking edges shall be trued by either square shearing or planing, or bevel shearing or planing.

35. Shearing and planing shall be done neatly and accurately. The distance from center lines of rivets to the edges of plates and the allowance for bevel shearing or planing shall be as shown in Table 2 of the Design Specifications. A tolerance of ± ⅛" will be permitted in dimension "A" after shearing or planing.

36. Plates to be scarfed may be heated to a cherry red color.

37. Rolling: After plates are punched and sheared they shall, when necessary, be shaped to the proper curve by cold rolling. Plates ⅜-inch thick and heavier shall be rolled to the specified radius for tanks 60 ft. and less in diameter; plates ½-inch and heavier shall be rolled for 78 ft., 102 ft., and 120 ft. tanks; and plates ⅝-inch and heavier shall be rolled for 144 ft. tanks.

38. Marking: All plates and roof members shall be marked as shown on the drawings.

SHIPPING:

39. Plates and tank material shall be loaded on cars in such a manner as to insure delivery without damage.

40. Bolts, nuts, rivets, railing connections, nipples and small details, shall be boxed, crated, or put in kegs or bags for shipment.

INSPECTION:

41. An inspector representing the purchaser shall at all times have free entry to all parts of the manufacturer's works while work under the contract is being performed. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications, and shall furnish, free of cost, any samples or specimens of materials for the purpose of testing. Inspection shall be made at the place of manufacture prior to shipment unless otherwise specified. The manufacturer shall give the purchaser ample notice as to when he will start fabrication, so that the inspector may be on hand when required.

42. Shop inspection shall not release the contractor from replacing any defective material which may be discovered in the field.

43. Any material or workmanship which in any way fails to meet the requirements of these specifications will be rejected by the inspector and must not be used under the contract. Material which shows injurious defects subsequent to its acceptance at the manufacturing works will be rejected and the manufacturer will be notified to this effect, and required to furnish new material.

PART III.

Erection Specifications

GENERAL:

44. The contractor or builder shall furnish all labor, tools, false work, scaffolding, and other equipment necessary for the erection of tanks complete and ready for use.

ASSEMBLING:

45. Plates shall be carefully and accurately "laid up," and shall then be firmly drawn together with common machine bolts or wedge bolts before riveting is commenced, placing bolts in at least one out of every five holes.

46. To insure full rivet section, equal to computed area, all holes in vertical shell seams shall be reamed after bolting up, using a reamer 1/16-inch greater in diameter than nominal diameter of rivet for hot driven rivets and 1/32-inch greater than nominal diameter for cold driven rivets. Holes properly punched and matched will not require the removal of any metal by the reamer, but the tool must be inserted in each hole as a gauge.

47. Burrs and fins on punched holes shall, if necessary, be removed in the field by a tool, countersinking not more than 1/16-inch.

48. No paint or foreign material shall be used between surfaces in contact, except asbestos caulking strip at end of each bottom seam, as shown on detailed drawings.

49. All field joints in shell, bottom and roof of tank shall be riveted unless welding is specified for roof plates or for top and bottom angles. All field joints in the roof supporting structure shall be bolted except that the column bases shall be riveted to the columns.

RIVETING:

50. The size and pitch of the rivets shall be as specified on the drawings. They shall be driven by pneumatic or hydraulic tools wherever possible.

51. Rivets ⅝-inch in diameter and under may be driven cold or hot, except that bottom rivets must be driven hot, unless special conditions make cold driving necessary. All rivets over ⅝-inch diameter shall be driven hot.

52. Rivets driven hot shall have steeple heads; the dimensions of snaps to be as shown in Figure 3-A.

53. Shell rivets, when driven cold, may be driven with either steeple or Liverpool snaps, the dimensions of the latter to be as shown in Figure 3-B. Bottom rivets, if driven cold, may be driven with either steeple or double radius snaps, as shown in Figure 3-C.

54. Tolerances in snap dimensions shown in figures to be 1/32-inch plus or minus; tolerances in finished rivet heads to be plus ⅛-inch over dimensions shown.

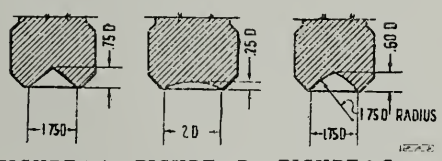

FIGURE 3-A Steeple Head — **FIGURE 3-B** Liverpool Head — **FIGURE 3-C** Double Radius Head

D=Nominal Diameter of Rivet

55. Heads shall be concentric with the rivet body. All rivets shall be driven from the outside of the tank, except the bottom, which may be driven from the inside. Any burned, loose or defective rivets shall be cut out and redriven. No foreign substance shall be used in the joints except as noted above.

CAULKING:

56. Seams shall be made tight by caulking. Roof and shell shall be caulked on outside, bottom on inside. The shell and bottom shall be caulked to bottom angle from the outside only. The caulking tools and methods used shall be such that the underlying sheet is not damaged, and the edge of the top sheet not turned under. A round-nosed tool shall be used to upset the metal. This operation shall be followed with a fine square tool. Split caulking on plates over ½-inch thick shall be acceptable. All shell openings shall be caulked inside and outside where possible. The work must be done by experienced men only.

57. The opening between ends of plates and outside butt-strap in butt joints shall be stopped by means of a wedge, or by welding, as specified in the order.

58. Inside butt-straps will not ordinarily be caulked; but if specially required by purchaser (in tanks where frequent changes of stock and cleaning are anticipated) this shall be done, and stoppers placed in openings between shell sheets and inside butt-straps as above.

59. Holes punched for erection purposes shall be closed tight, either by welding up, by driving in a "burr" and welding over, or by filling with a rivet.

WELDING:

60. All welding specified on drawing shall be done by the electric or oxy-acetylene process. When a lap weld is used, the width of the bead shall be approximately the thickness of the material. Welding shall be done by experienced operators only. Finished seams must be free from warps.

TESTING AND LOWERING OF BOTTOM:

61. The bottom and lower part of the first course of tank shall be riveted and caulked while supported above the grade.

62. Where water is available, the tightness of bottom shall be tested with 6 inches of water before lowering to foundation; bottom shall be entirely tight to the satisfaction of the purchaser's inspector before lowering.

63. If water is not available, tightness shall be tested after lowering by pumping oil, which shall be supplied by purchaser, underneath bottom, maintaining a pressure of 6 inches of oil by holding that depth around the edge inside a temporary dam; bottom shall be made entirely tight, to the satisfaction of the purchaser's inspector.

64. All reasonable care shall be taken to preserve the prepared grade under the tank, and before the bottom is lowered it shall be re-shaped if necessary, to the satisfaction of the purchaser's inspector.

Testing Shell and Roof:

65. Upon completion, the entire tank shell shall be tested by filling with oil or water to the level of the top angle. If it is not feasible to fill the tank as indicated, the test may be made by painting all seams on the inside with a highly penetrating oil, such as automobile spring oil, examining the outside of the seams for leakage. All leaks discovered by the above tests shall be stopped.

66. The roof shall be tested by applying an internal air pressure equivalent to not less than ½-inch of water, and applying strong soap solution to all seams. All leaks discovered shall be stopped.

67. Before acceptance, entire tank, when filled with oil, must be tight and free from leaks.

Cleaning Up:

68. Upon completion of the erection, the contractor will remove or dispose of all rubbish and other unsightly material caused by his operations and will leave the premises in as good a condition as he found them.

Inspection:

69. An inspector representing the purchaser shall at all times have free entry to all parts of the job while work under the contract is being performed. The manufacturer shall afford the inspector, free of cost, reasonable facilities to satisfy him that the work is being done in accordance with these specifications.

70. Any material or workmanship which in any way fails to meet the requirements of these specifications will be rejected by the inspector and must not be used under the contract. Material or workmanship which shows injurious defects subsequent to its acceptance at the manufacturing works will be rejected and the manufacturers will be notified to this effect, and will be required to furnish new material or correct defective workmanship.

Appendix A.

1. Rules for Computation:

(A) Reinforcement of Opening in Tank Shell

a-1. In computing the necessary reinforcement of an opening in a tank shell (See Design Specification, Par. 11), the net area of the reinforcement shall bear the same ratio to the area of metal removed from the shell as the strength of the vertical joint in the shell course bears to the strength of the solid plate.

a-2. Sufficient rivets shall be used to transmit to the shell plate by shear the full strength of the reinforcing ring or flange, at a maximum unit shear of 16,000 lbs. per sq. in.

a-3. In computing the net reinforcing area of a fitting, such as a boilermaker's flange or manhole flange having a neck, the material in the neck may be considered as part of the flange, for a height, measured from the surface of the reinforced sheet, equal to four times the thickness of the material in the neck.

(B) Computing Back Pitch of Rivets

b-1. If P/d is 4 or less, the minimum value shall be 2d.

b-2. If P/d is over 4, the minimum value shall be: $2d + 0.1\ (P\text{-}4d)$.

where

"P" equals pitch of rivet, in inches, in outer row where a rivet in the inner row comes midway between two rivets in the outer row.

"P" equals pitch of rivets, in inches, in the outer row less pitch of rivets in the inner row where two rivets in the inner row come between two rivets in the outer row.

(It is here assumed that the joints are of usual construction where rivets are symmetrically spaced.)

"d" equals diameter, in inches, of the rivet holes.

b-3. The pitch of rivets shall be measured either on the flat plate before rolling, or on the median line after rolling.

TABLE 6—PERMISSIBLE VARIATIONS OF RECTANGULAR PLATES ORDERED TO WEIGHT.*

Ordered Weight, Lb. Per Sq. Ft.	Permissible Variations in Average Weights per Square Foot of Plates for Widths Given, Expressed in Percentages of Ordered Weights																		Ordered Weight, Lb. Per Sq. Ft.
	Under 48 in.		48 to 60 in., excl.		60 to 72 in., excl.		72 to 84 in., excl.		84 to 96 in., excl.		96 to 108 in., excl.		108 to 120 in., excl.		120 to 132 in., excl.		132 in. or over		
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	
Under 5	5	3	5.5	3	6	3	7	3	..	..	..	..	..	..	..	..	..	..	Under 5
5 to 7.5 excl.	4.5	3	5	3	5.5	3	6	3	..	..	..	..	..	..	..	..	..	..	5 to 7.5 excl.
7.5 " 10 "	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	..	..	..	..	7.5 " 10 "
10 " 12.5 "	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	9	3	10 " 12.5 "
12.5 " 15 "	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	12.5 " 15 "
15 " 17.5 "	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	15 " 17.5 "
17.5 " 20 "	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	17.5 " 20 "
20 " 25 "	2	2	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	20 " 25 "
25 " 30 "	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	5	3	25 " 30 "
30 " 40 "	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	30 " 40 "
40 or over	2	2	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	40 or over

NOTE.—The weight per square foot of individual plates shall not vary from the ordered weight by more than 1⅓ times the amount given in this table.

*Copied from A. S. T. M., and Association of American Steel Manufacturers Specifications.

PURCHASING AGENTS' REFERENCE LIST OF PRODUCTS

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OF CALIFORNIA

Absorption Plants
Accessories, Oil
Accumulators
Acid Tanks
Agitators
Air Condensers
Air Receivers
Air Pipe

Black Steel Tanks
Boilers
Bolted Tanks
Braces, Pressed Steel Car
Brine Tanks
Buildings, Steel
Burners, Refuse

Car Sills, Pressed Steel
Casing, Oil Well
Casing, Water Well
Condenser Boxes
Cooling Towers
Corrugated Culverts
Corrugated Tanks
Culverts, Metal

Dephlegmators
Dredge Pipe

Evaporators

Filters
Fire Stills
Flumes, Steel
Fuel Oil Storage Tanks

Galvanized Air Pipe
Galvanized Culverts
Galvanized Irrigation Pipe
Galvanized Tanks, Corrugated
Galvanized Tanks, Straight Side
Gas Holders
Gas Traps
Gasoline Storage Tanks
Gasometers
General Plate Work
Gravity Tanks
Grease Kettles

Heat Exchangers
Heaters
Hemispherical Bottom Tanks
Holders, Gas
Hydro-Pneumatic Pressure Tanks

Ice Cans
Irrigation Pipe, Galvanized

Kettles, Grease
Kettles, Steam Jacketed

Lock-Bar Steel Pipe

Metal Culverts
Metal Flumes

Oil Accessories
Oil and Gas Separators
Oil Refinery Equipment
Oil Storage Tanks, Steel
Oil Well Casing

Parts, Pressed Steel
Penstocks, Steel
Pipe, Dredge
Pipe, Galvanized Air
Pipe, Galvanized Irrigation
Pipe, Gas Gathering
Pipe, Lock-Bar Steel
Pipe, Riveted Steel
Pipe, Slip-Joint
Pipe, Soil Proof
Pipe, Steel
Pipe, Welded
Pressed Steel Work
Pressure Tanks
Purifier Boxes

Receivers, Air
Refinery Equipment
Refuse Burners
Retorts
Riveted Steel Pipe
Riveted Steel Tanks
Rock Screens
Roof Pressure Tanks

Smokestacks
Soil Proof Pipe
Special Fittings
Special Shapes
Special Tanks
Standpipes
Station Tanks
Steam Stills
Steel Buildings
Steel Flumes
Steel Penstocks
Steel Pipe
Steel Plate Construction
Steel Tanks
Stills
Storage Tanks, Steel
Stovepipe Casing
Structural Steel Work

Tanks, Acid
Tanks, Bolted
Tanks, Black Steel
Tanks, Brine
Tanks, Cylindrical
Tanks, Galvanized Corrugated
Tanks, Galvanized Straight Side
Tanks, Gravity
Tanks, Hemispherical Bottom
Tanks, Hydro-Pneumatic Pressure
Tanks, Oil Storage
Tanks, Pressure
Tanks, Riveted
Tanks, Roof
Tanks, Shaped
Tanks, Ship
Tanks, Tower
Tanks, Truck Single or Multiple Compartments
Tanks, Wagon
Tanks, Welded
Towers, Cooling
Towers, Steel Tank
Traps, Gas

Wagon Tanks
Water Pipe Lines
Water Well Casing
Welded Pipe
Welded Tanks
Wrapped Pipe

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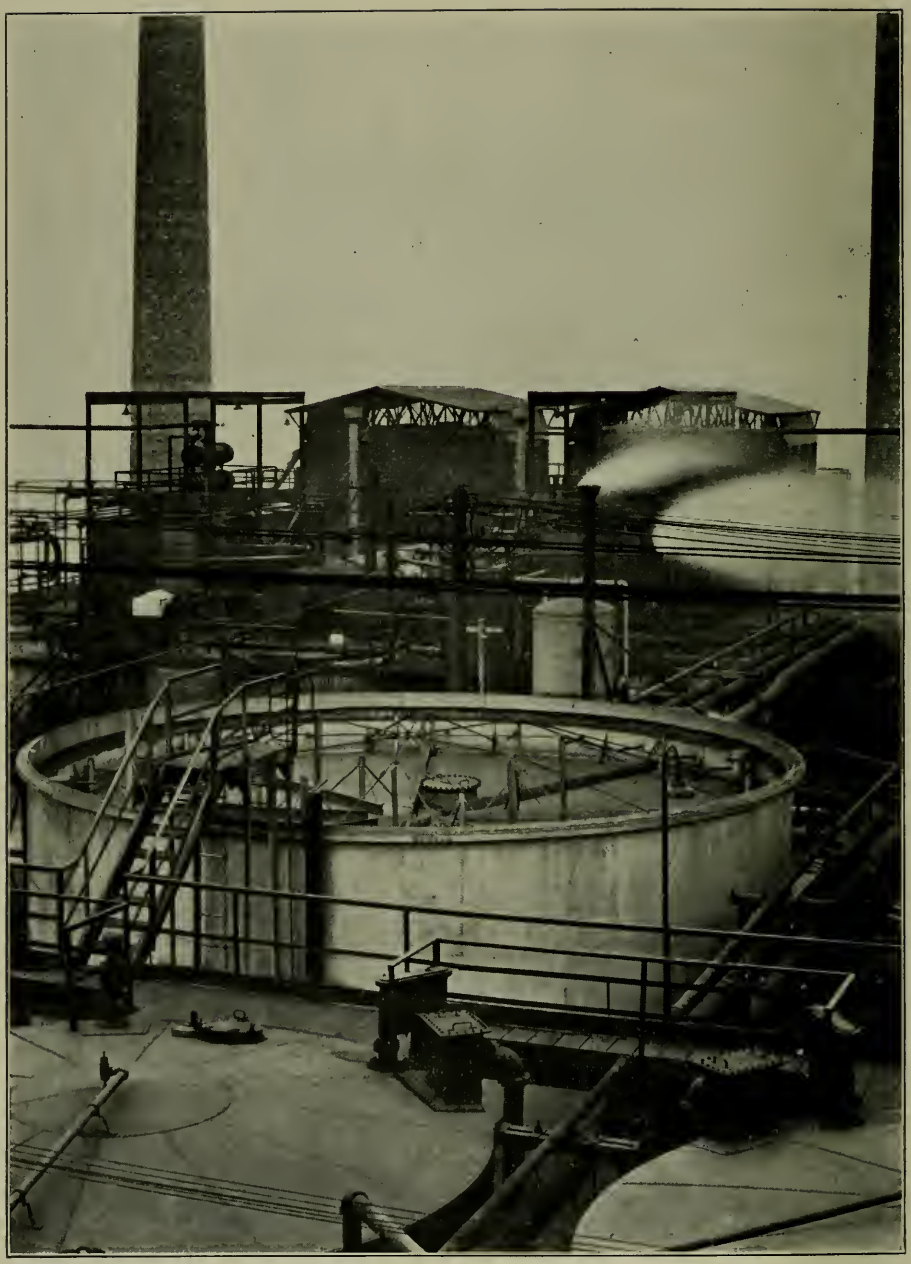
WESTERN PIPE AND STEEL NEWS



ATLANTIC REFINING CO. USES WIGGINS FLOATING ROOFS.—*The above view shows Wiggins Floating Roof on a 35-ft. diameter tank in the midst of the Atlantic Refining Co.'s Pittsburgh, Pa., plant.*

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Western Pipe and Steel Company Adds Wiggins Floating Roofs to List of Oil Industry Products

WESTERN PIPE AND STEEL COMPANY of California is now manufacturing and selling Wiggins Floating Roofs under license and agreement with the Chicago Bridge & Iron Works and the Wiggins interests. In connection with this announcement there are presented herewith some interesting facts and figures about Wiggins Floating Roofs and a number of illustrations of their installation on oil storage tanks in various parts of the country.

The economic value of the Wiggins Floating Roof is well known. Its function is two-fold—first, it stops evaporation losses; second, it does away with fire hazard.

The Wiggins Floating Roof is a circular steel deck and a seal. The deck, which is approximately 16 inches less in diameter than the tank (about eight inches all around) and has a high vertical steel rim at its outer edge, rides directly on the surface of the liquid. The bottom of the deck is constructed of 3/16-inch plates and the rim of ¼-inch plates. Considering that the under side of the deck is protected from corrosion by the oil and that the top is open for painting, plates of this thickness give the roof a life equivalent to the life of the tank.

The eight-inch space between the deck rim and the tank shell is closed with a seal, consisting of a series of vertical shoes and a continuous band of flexible material connecting the top of the shoes to the top of the deck rim. The shoes, which are from two to three feet long and 40 to 50 inches high, are joined end to end in a continuous band with the same type of flexible material and supported from the deck with spring hangers which hold them in parallel contact with the tank shell at all times.

Ordinary, diligent attention, such as should be given any oil tank is all the Wiggins Floating Roof requires. It has no continuous operating expense as have some recovery systems. The roof rides on the oil. There is no gas space over the oil, with the exception of the small annular sealed-in space adjacent to the shoes, and consequently no opportunity for vapor to rise from the liquid. Evaporation is stopped.

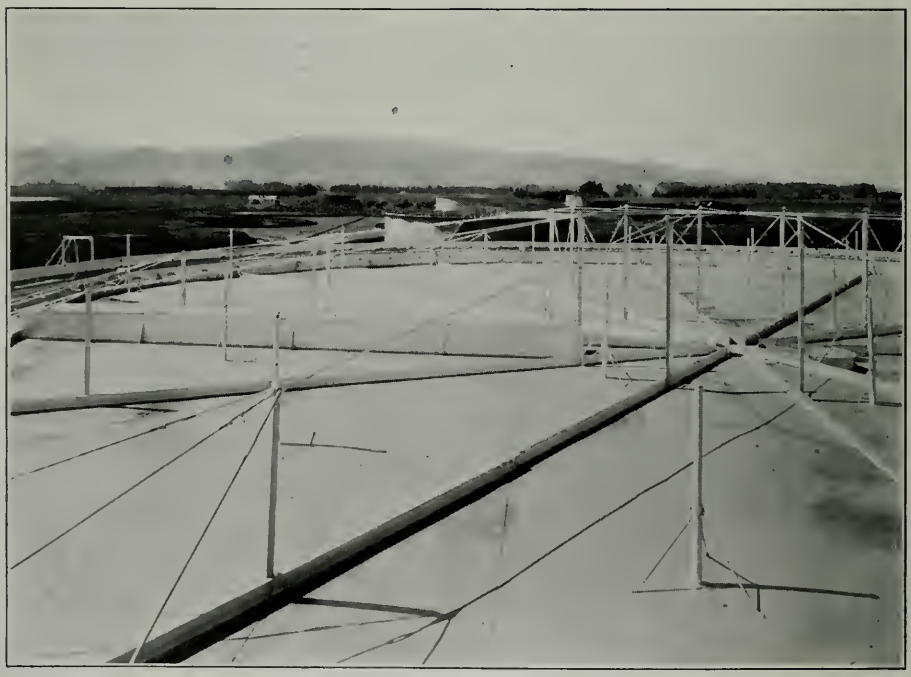
The Wiggins Floating Roof stops fire by removing the hazard. In other words, it removes the conditions which might allow the contents of the tank to burn. Air cannot reach the oil under the deck, consequently it cannot be ignited. In addition to there being no vapor space under the deck, no explosive mixture is held above it. The type of construction used at the "sealed space" allows gases being pumped in with the oil to be disposed of through liquid sealed vents.

The space between the deck and the shoes of a Wiggins Floating Roof is covered with a fire-resisting flexible material. Fire igniting the vapor inside the seal (it rarely does, but it has been done intentionally in tests) puffs out the vents and then is snuffed out when the vents close. Should a portion of the seal be blown out (another rare likelihood) the flame could burn through that small opening for hours without impairing the roof and could be quenched easily by one man with a small extinguisher.

The best proof that Wiggins Floating Roofs prevent fire is their performance in the field. They have been installed under every conceivable condition and the contents under no one of them has ever been destroyed by fire or lightning.

Recent research has developed an interesting angle on evaporation losses. It separates such losses into two classes. The first class, which has always been understood, is simply volumetric. If there are 80,000 bbls. of oil in a tank today and during the year 1,000 bbls. pass off in the form of vapor, the tank will contain only 79,000 bbls. at the end of the year. The second class of loss is equally simple but is determined in a quite different way. It is the loss which is due to decrease in gravity and consequent lowering in the price of the oil.

For illustration, let it be assumed that an oil company is holding 1,000,000 barrels of oil in ordinary steel storage tanks. Volumetrically the loss in one year would be about 1%, but this would result in a 1/2.5 degrees drop in gravity or an 0.4 degrees drop. With a differential in the



Close-up view of one of several Wiggins Floating Roofs on 80,000 bbl. oil tanks of the Union Oil Co. of California, San Luis Obispo.

price of oil of 5c per degree, 0.4 degrees times 5c equals 2c—the loss in price per barrel suffered on the entire quantity in storage.

Thus the 1,000,000 bbls. dwindles to 990,000 bbls. in the course of a year due to the 1% volumetric loss, and the drop in gravity amounts to 2c per barrel, the money loss on which is $19,800. This amount is greater than the volumetric loss which figures 10,000 bbls. at $1.60 per barrel or $16,000. The total of the two amounts is $35,800.

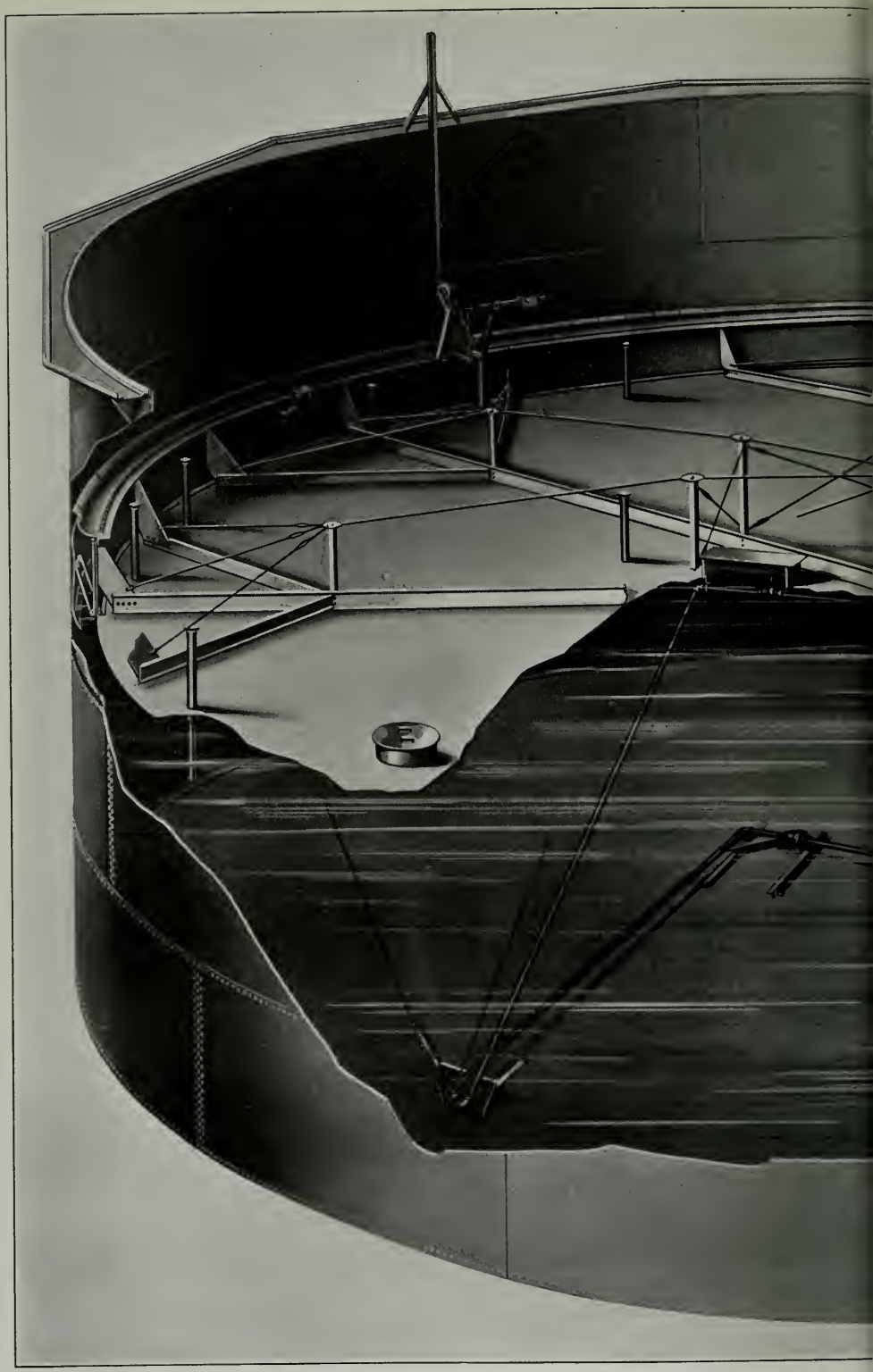
The drainage system is an important feature of the Wiggins Roof. Rainfall drains toward the center of the deck into a square sump. The drainage system, which carries water to the outside of the tank, is shown in detail in the cutaway illustration in the double spread of this issue.

It consists of a series of pipes and flexible joints arranged in such a manner that the pipes move up and down with the movement of the roof.

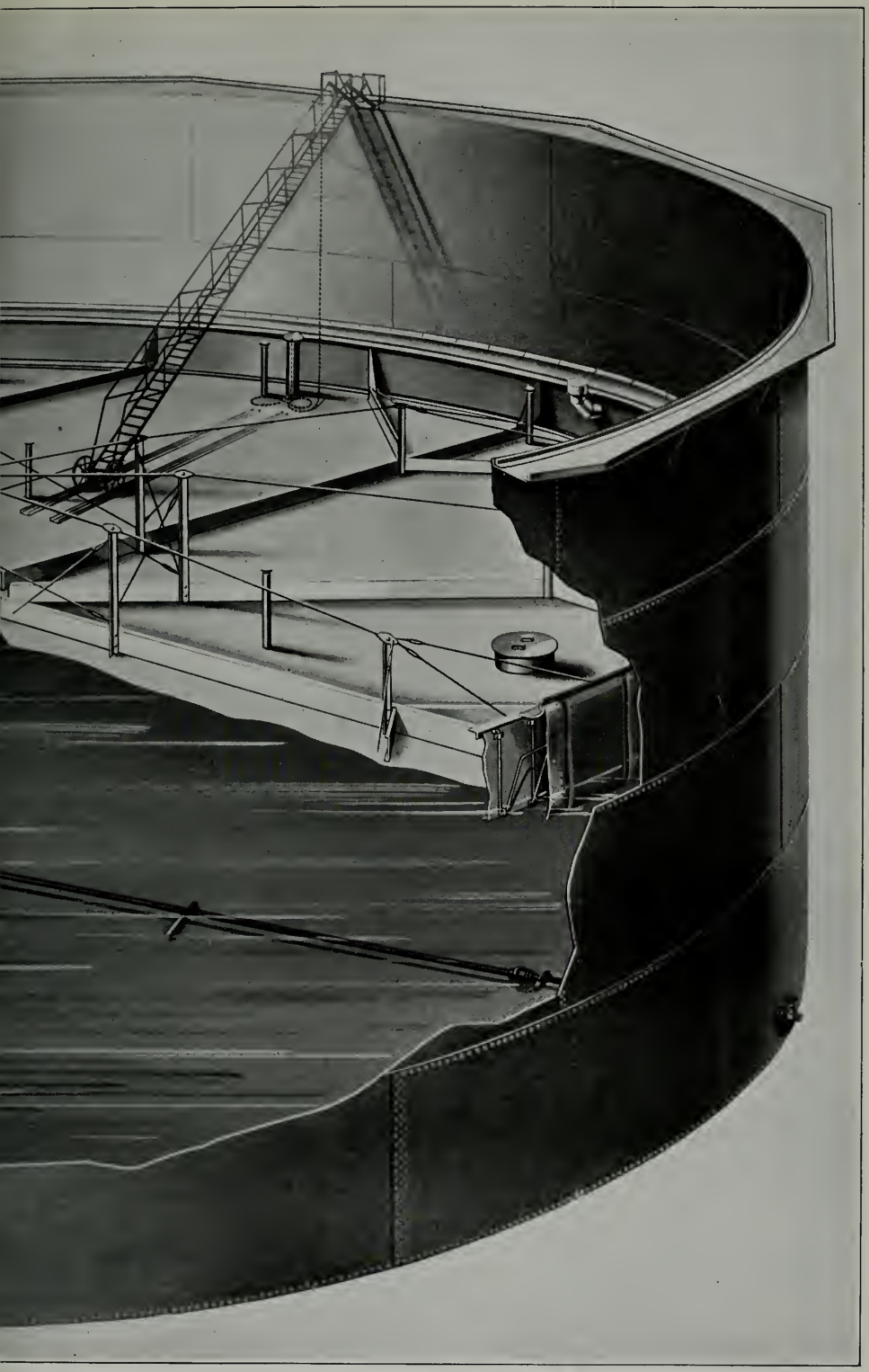
Wiggins Floating Roofs are equipped with legs which hold the roof 2 feet 6 inches off the tank bottom as a minimum. These legs are adjustable from the roof deck and in tanks where pipe connections, heater coils, etc., require or where the customer desires, the legs may be set to support the roof at any height up to 5 or 6 feet from the tank bottom. These special legs are desirable where it is necessary to clean the tank often or where it is necessary to get under the roof for other reasons.

On various careful tests made with tanks equipped with Wiggins Floating Roofs the saving of evaporation losses effected by these roofs has consistently approximated 100%.

This picture shows eight 42-ft. diameter tanks of the Marland Refining Co. at their Ponca City, Okla., refinery, all with Wiggins Floating Roofs.



CUTAWAY DRAWING SHOWING THE CONSTRUCTION OF THE
the seal closes the gap between the deck and the tank shell, and the cons



FLOATING ROOF.—*Note how the deck rides on the surface of the oil, the drainage system carries water from the deck outside of the tank.*

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EDITED BY RICHARD PROSSER

IN KEEPING with the tradition of progressiveness which has always been the policy of Western Pipe and Steel Company of California, we have added a new product to our list. For many years we have specialized in the fabrication and erection of oil industry equipment and it was therefore logical that the Wiggins Floating Roof should come into the "Western" line of specialties.

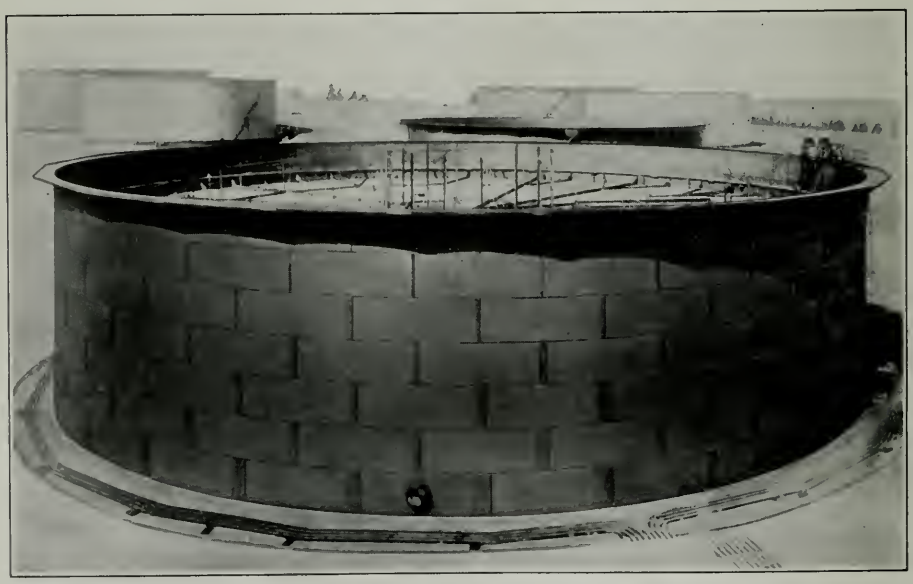
It has many features to recommend it, not the least being the economy effected through its use.

A very practical illustration of the economy of the Wiggins Floating Roof is expressed in the statement that the savings in evaporation alone will pay for the roof in a short time, and the tank owner has the fire protection feature without cost.

The Wiggins Floating Roof, which is marked by simplicity of construction, can be installed in any existing tank or on new tanks. When installed on existing tanks the oil companies usually commercially clean the tank and see that it is a safe place for the erection crew to work.

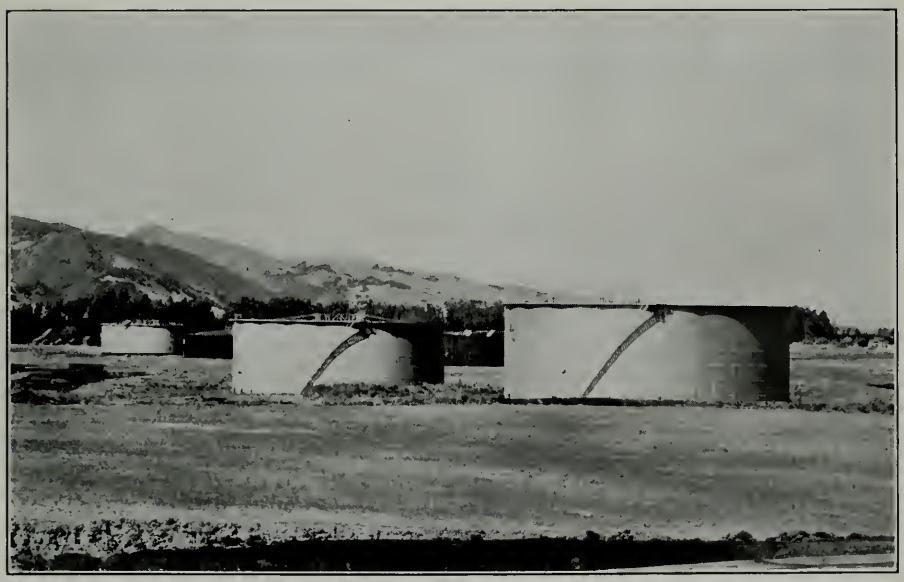
There is no operating expense and no pumps or compressors to run. The Wiggins Roof moves up and down with the oil level, automatically sealing the oil in and the air out. It is known and used widely in twenty-one countries outside of the United States.

THE COVER PICTURE.—*Looking toward the Golden Gate over two 114 ft. 6 in. diameter oil storage tanks with Wiggins Floating Roofs, Standard Oil Company of California, San Pablo.*

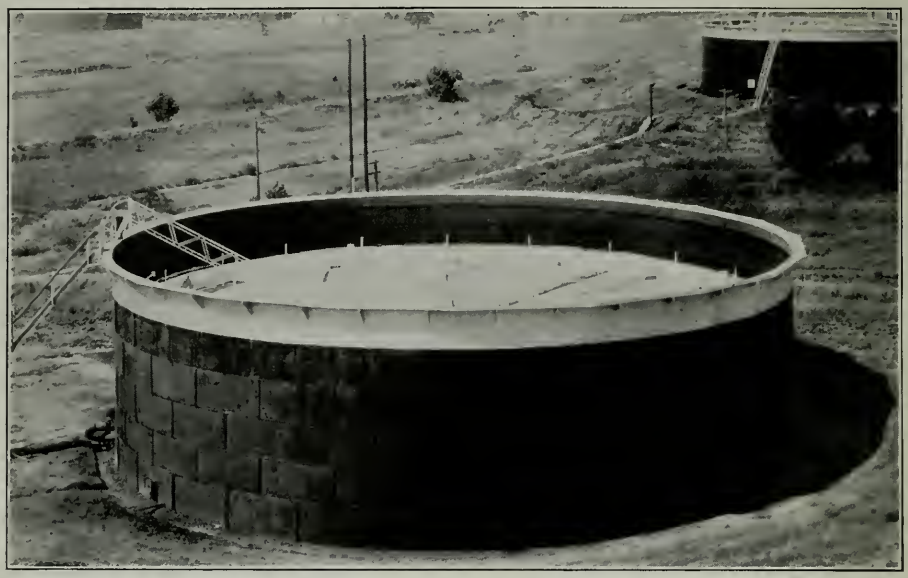


Wiggins Floating Roof on 150-ft. diameter oil storage tank of the Union Oil Co. of California, at Wilmington, Cal.

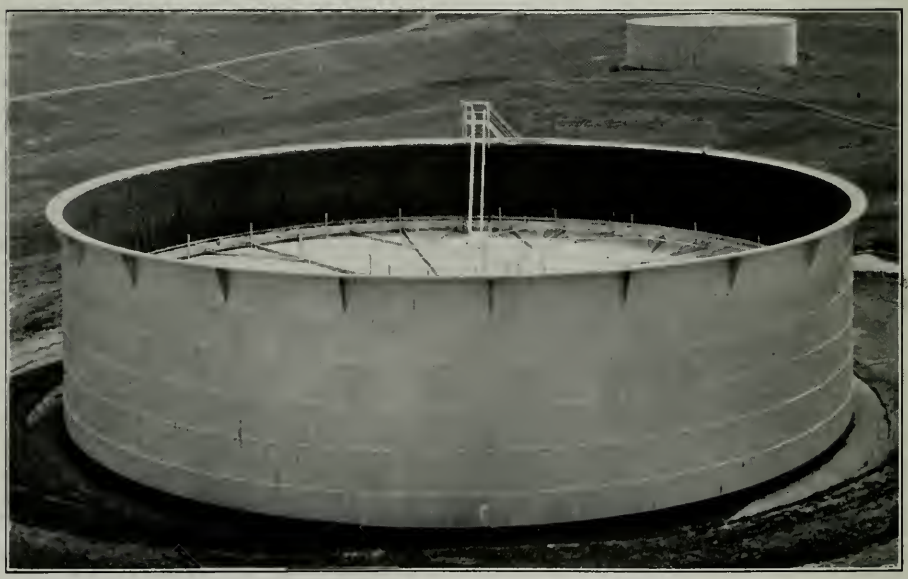
View taken at San Pablo, Cal., showing five oil storage tanks 114 ft. 6 in. diameter, with Wiggins Floating Roofs. Standard Oil Co. of California.



General view showing three Wiggins Floating Roofs on 80,000 bbl. tanks of Union Oil Co. of California, at San Luis Obispo.



This 95 ft. 6 in. diameter tank with Wiggins Floating Roof was erected for the Prairie Pipe Line Co.'s station at Drumright, Okla. There are three other similar tanks at this station.



One of five 114 ft. 6 in. diameter tanks with Wiggins Floating Roofs erected for the Standard Oil Co. of California, at San Pablo.

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Galvanized Tanks, Straight Side
Gas Traps
Gasoline Storage Tanks
Heat Exchangers
Oil Accessories
Oil Storage Tanks
Oil Well Casing
Pipe, Welded
Spiral Steel Stairways
Stills, Oil
Stovepipe Casing
Swing Pipes
Wiggins Floating Roofs
Etc., Etc.

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